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ENGLISH MECHANIC

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WORLD OF SCIENCE.

WITH WHICH ARE INCORPORATED

"THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

ILLUSTRATED WITH NUMEROUS PRACTICAL ENGRAVINGS.

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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

LATHE SCREWS AND MANDREL NOSES.

THE discussion on ornamental lathe screws and mandrel noses carried on in our columns during the last four volumes is at last fairly before the members of the Amateur Mechanical Society, an occasional number of their *Journal* having been issued with the express purpose of submitting the question to the members, who, if they act in their corporate capacity, can at any rate set the fashion so far as amateurs' lathes are concerned. We need not even summarise what has been said in our columns, for the gist of the whole matter, pro. and con., will be found in the first half of the last volume; but for the benefit of readers who are not lathemen, we may say that the question is of a similar character to that practically settled by the Royal Microscopical Society, when it issued what is known as the Society's screw, and also to that which has long agitated the wire-drawing world, which latter will probably be settled by the electricians without the consent, or without so much as "by leave," of the gentlemen who are kind enough to make wire of all sorts of gauges, and call it by numbers which mean one thing here and another there. Thanks to the action of the Royal Microscopical Society, an amateur can now buy a stage of any maker of repute, and know that if at any time he wishes to add to his battery of objectives, he will experience no difficulty in consequence of a difference in the screw-thread. The question is, Whether lathe-makers might not with advantage adopt recognised standard threads for the various parts of their machines (about which, we believe, there is no dispute); and whether 10 threads to the inch is not better than 9·45 (or some number approximating to that), or than 13·09? It will be remembered that on the 11th of October, 1882, the Council of the Amateur Mechanical Society passed some resolutions on the subject, which were afterwards repassed on Jan. 10, 1883, in the following form, recommending—

1. A rate of 10 threads to the inch for the geometric mandrel-nose and back-centre screw.

2. An enlarged cylinder base in place of the present circular groove at the root of the mandrel-nose.

3. A thread of 50°, truncated 7¼ per cent. of its pitch for the mandrel-nose and other fine pitches.

These resolutions were subsequently found to be informal, and it was then determined to submit the question to the members of the Society by issuing an "occasional" number of the *Journal*, which can now be had of Messrs. Trübner, Ludgate-hill, for two shillings. In this number, Dr. Edmunds sets out his views at length in a "Memorandum upon Ornamental Lathe-Screws," and in a paper entitled, "Suggestions for a Standard Mandrel." In the first he states the case quite as fully as is necessary, and gives such information as will enable the members of the Society to decide as to what aliquot screw-threads should be recommended for new geometric lathe apparatus. It must be remembered that in slide-rests the "ornamental screws" have already been superseded by the screw of ten threads to the inch, and the question is now whether it would not be possible to set up a standard series of screw sizes, so that if a screw is removed from one lathe it will fit another of the same size; or, in other words, so that the parts can be kept in stock at the tool-shops, and be obtained at the shortest notice. It is not a question of whether the screws adopted by famous makers are suitable for the work they are called upon to do, but one of convenience to their users, and, if makers would but understand it, of sound business policy. It cannot be argued that screws having 9·45, 13·09, 19·89, 25·71, and 55·11 threads to the inch have any special virtue in the decimal figures, whereas a purchaser does see a very great virtue in a machine all the smaller parts of which he can duplicate at the nearest machinists' tool-shop, and all the screws of which he can either buy or cut by means of an ordinary lathe and a small battery of change wheels. Owners of costly lathes will not agree with Dr. Edmunds that screws having aliquot rates ought to at once supersede those having fractional rates; because, as soon as a series of standards is adopted, the commercial value of the older lathes will be materially reduced, however excellent they may be as tools; but the great majority of amateur workers with the lathe will, undoubtedly, vote for standard sizes, and for screws which can be readily reproduced. Dr. Edmunds, in his "memorandum," proposes that the comb screw tools and mandrel guides should be denoted by numbers indicating the threads per inch; taps and dies by the number, and also by the outside diameter of the threads; and he also suggests that all bolt-heads, nuts, &c., should be made to one or other of the Whitworth standards, and that the number of sizes in use should be as small as practicable. With regard to Dr. Edmunds' suggestions for a standard mandrel, they are as follows:—

1. The face of the mandrel to be made much larger than at present, with a view to minimise the tendency to angular variation in the setting of the chucks.

2. The base of the mandrel-nose to be a true cylinder, palpably larger than the outside of the thread, to which the first part of the chuck-bore will be accurately gauged, so as to minimise the tendency to excentric variation in the position of the chucks.

3. The face and nose of mandrel to be finished as may be, without risk of chipping or fracture, &c.

4. The mandrel to be drilled out, &c.

5. The mandrel-nose to be coned out in front, &c.

6. The mandrel-nose to be screwed with the thread he describes, and at the rate of ten threads to the inch.

Dr. Edmunds proceeds to give the dimensions he would adopt, as we understand him, from experimental models he has made, and concludes with his reasons for asking the council to consider the question with a view to formulate a collective judgment.

At the meeting of the Society at which it was decided to publish an "occasional" number of the *Journal*, the hon. sec., Mr. T. W. Boord, M.P., observed that there were other views worthy of consideration, and it would be necessary to take care that the members were fully informed before being asked to express an opinion. In his capacity as editor of the *Journal*, Mr. Boord has given Dr. Edmunds every encouragement to make his paper as complete and exhaustive as possible; and besides appending some remarks of his own, has called upon two representative amateurs, General G. C. Clarke and Rev. S. B. Burnaby, to state their opinions. As these are printed in the "occasional" number, we may, it is to be hoped, shortly expect to hear the decision of the members of the Society. General Clarke supposes everybody is agreed that if all screws were to be started afresh, it would be desirable that aliquot parts of the inch should be invariably employed in determining their respective pitches, which should bear a fixed proportion to the diameters of the screws, and he agrees with Dr. Edmunds in wishing that in all future apparatus the makers of lathes, &c., should adopt such a standard. General Clarke thinks, however, that, as the lathes and screws in question have been copied, and are in use all over the world, Dr. Edmunds has somewhat exaggerated the supposed defects of those screws, and some of his objections to them appear fanciful rather than practical. He points out, too, that it is only in parts of the lathe that screws have been selected without reference to the particular pitch of each, and that where uniformity is necessary, screws of ten threads to the inch are employed. With reference to the suggestion that if the back-centre screw of 13·09 threads to the inch had been made with ten threads, and the head divided to hundredths, the depth to which the boring-screw had advanced would be accurately known by the number of the turns of the handle, General Clarke points out that it is necessary to withdraw the boring-tool repeatedly to clear away the shavings, and to do that in the readiest manner is to run back the back-centre bodily, and that being done, he asks what becomes of the accurate measurement of the depth of the bore? General Clarke says that for forty years he has not experienced the inconveniences which he is supposed to have suffered. He has comb-tools to match each guide, and that is all he finds necessary; while every screw about his lathe agrees with one or other of the guides, so that they can be easily replaced if broken. The Rev. S. B. Burnaby treats the question in a very different style, for he evidently thinks it "much ado about nothing." He points out that the question was "unanimously" resolved to be put at a meeting of the Amateur Mechanical Society, when two members were present—the mover and seconder of the resolution. Then he proceeds to say that "we shall be asked whether we prefer threads of 13·09 or 19·89 to those of 13 or 20, and so on," and he thinks that a large majority of people will answer, "No, we do not"; in fact, most people will be unable to see the use of asking such a question. If a further question is asked, whether the "people" much care whether the binding or fastening or holding down screws of the apparatus be 36·1 or 36, the answers, he thinks, may vary, some saying "they do care," and others "they don't care." The Rev. S. B. Burnaby thinks that the accident of the loss or breaking of a screw does not occur frequently, and he further thinks that if such screws can be purchased for "a few pence" they will be cheap at the price. He thinks that all troubles under this head would cease if the owner of the lathe would purchase a stock and set of dies, and a few screw tools adapted to his lathe, no matter what terrible decimals are to be found in the rates of its screws. There are no lathe-makers, he says, who make the leading and measuring screws of their apparatus, whether for slide-rest or "ornamental" chucks, other than of aliquot rates. With regard to 9·45 for the nose of the lathe, Mr. Burnaby says there "is not the least difficulty in arranging a set of wheels to cut this thread, any more than in cutting one of nine pitch," and a calculation which would occupy five minutes would last a lifetime. With respect to the proposed new form of mandrel-nose, he says, "no practical man would think of adopting such a concern"; the neck should on no account be of greater diameter than the nose itself; and "any ordinary workman trying to fit chucks to such a mandrel . . . . would simply and totally fail."

The hon. sec., Mr. T. W. Boord, M.P., also replies much to the same effect, but reduces the whole case to the simple question whether, if the back-centre screw of 13·09 threads to the inch were made with ten threads, it would enable the turner to accurately and easily gauge the depth of a hole *drilled with the aid of the back-centre.* He gives practically the same reasons as General Clarke why it would not, explains why he objects to Dr. Edmunds's proposed dimensions for the mandrel-nose, and thinks if the interchangeability of chucks were brought about, it would be of little use. We have thus endeavoured to give an idea of the arguments pro and con., which are set out very fully in the *Journal*, and those interested should carefully study the question as there set out before making a final judgment.

DIMENSIONS AND RESISTANCE OF WIRES.—II.

By John T. Sprague.

15. THE different essential facts as to the conductivity and resistance of the most important metals are given Table I., derived from Mathiessen's measures taken in connection with the preparation of the original ohm. Later determinations differ, and a set by Benoit may be found, p. 112, Vol. IV. of the "Journal of the Society of Telegraphic Engineers"; but Mathiessen's values are generally received, and his well-known care and the means at his disposal justify the retention of his values.

Table I.—Conductivity and Resistance of Metals.

I.	II.	III.	IV.	V.	VI.	VII.	VIII.
	Specific.		Conductivity Silver = 100.		Resistance at 32° Fahr. of 1ft. of wire		
Metals Pure.	Gravity = s.	Resistance Microhms = R	Weight.	Section.	weighing 1 grain = U	of 1 mil. diameter = u	Variation per cent. 1° Fahr.
Aluminum	2·574	2·944	204·05	51·67	·1085	17·72	...
Antimony.........	6·725	35·907	6·41	4·24	3·456	216·00	·216
Bismuth	9·817	132·658	1·19	1·15	18·64	798·	·196
Copper, hard	8·905	1·652	105·13	92·06	·2106	9·940	...
„ soft	8·927	1·616	107·27	94·17	·2064	9·718	·215
Gold, soft	19·339	2·081	37·853	73·09	·5849	12·52	·202
Iron, soft	7·781	9·825	20·18	15·63	1·097	59·10	...
Lead, pressed	11·392	19·847	6·84	7·65	3·236	119·39	·215
Mercury	13·593	96·185	1·18	1·58	18·720	578·60	·040
Nickel	8·513	12·579	14·42	12·08	1·535	75·78	...
Platinum, soft	21·437	9·158	7·88	16·56	2·810	55·09	...
Silver, hard	10·241	1·652	91·45	92·10	·2421	9·936	·209
„ soft	10·188	1·521	100·	100·	·2214	9·151	...
Tin, pressed	7·284	13·359	15·56	11·39	1·396	80·36	·202
Zinc, pressed	7·162	5·689	37·97	26·74	·5831	31·22	·202
Alloys.							
Brass .... about	8·4	8·266	12·18	18·45	·9938	49·72	...
German silver „	8·734	21·165	8·35	7·19	2·652	127·32	·024
1 Silver, 2 Platinum ...	12·21	24·661	5·22	6·17	4·243	148·35	·017
1 Silver, 2 Gold	15·213	10·788	9·16	13·84	2·391	66·10	·036
Carbon .... about	1·6	4196·	·2383	·0263	96·050	25240·	—·030

Different figures are given in various books, and the specific gravity and specific resistances are by no means too certainly known; but, as it appears absurd to present a set of values in one table which cannot be made to agree, with the result that the student has no definite starting point, I have calculated the whole of this table from the two values of Cols. VI. and VII. by means of the formulæ § 26. Therefore, should any other values be deemed more accurate, there will be no difficulty in altering the whole range of values, which are physically dependent on each other.

Col. III. is the *specific resistance*, that of 1 cubic centimetre expressed in microhms. By shifting the decimal point 6 places to the left it becomes ohms, and by shifting it 3 places to the right it becomes C G S units: thus copper = 1·652 microhms, ·000001652 ohm, and 1652· C G S units. Microhms are convenient for metals, ohms for liquids, and megohms for dielectrics.

16. The line of carbon is derived from my own experiments, and relates to the artificial carbons, such as are prepared for the Jablochkoff candles and arc lamps. The specific gravity is probably greater in the carbon of incandescent lamps, but it is scarcely possible to measure it, as the adhering film of air prevents its being properly weighed in water. It is probable also that the specific resistance is lower; but to discover this, either the specific gravity must be known, or the diameter, which is equally difficult to measure experimentally.

Correction for Temperature.

17. It is convenient to adjust resistances at the ordinary temperature, 60° Fahr., for which reason, also, the values are given in the formulæ and tables at that point. But it is necessary for many purposes to know the resistance corresponding to a temperature different from that at which observations are made, for temperature plays a very important part in the resistance of wires; in fact, it is difficult to get the same resistance twice for a piece of copper wire, if it is touched, or if the slightest change takes place in the room.

The variation with temperature does not occur equally for each degree, but in a curve. For all ordinary purposes, however, the correction may be taken for each degree Fahr., near about 60° as being—

Copper	as 1 to 1·00215	log.	0·0009327
German silver ..	„ 1·00024	„	0·0003126

and the correction is made by multiplying the decimal portion or the logarithm by the number of degrees (not by the logarithm of the degrees), and multiplying the resistance observed, for higher temperature, and dividing for lower temperature; adding or subtracting, as required, the logarithmic correction to the logarithm of the observed resistance.

Thus, to correct from 60° to 32°, or the freezing point (zero Cent.) is 28° ·00215 × 28 = 1·0602 for copper. The correct figure due to the full curve is 1·0605.

18. It is probable that these figures apply only to moderate heats, and Müller gives the following resistances for high temperatures of certain wires experimented on.

Iron.		Copper.		Platinum.	
0° Centi.	640	0° Centigrade	814	0° Centi grd.	1870
21°	681	21°	864	21°	1986
[illegible] ..	1065	Slightly incandescent ..	2100	Slightly incandescent.	4300
Dark red	329	Carmine red ..	2450	Red hot	4700
Bright red .	3650	[illegible] red	3300	Orange.........	5400
White heat	458	Bright red ...	4700	Light yellow.	6000

On the other hand, carbon as in the incandescent lamp has a resistance, when cold, just about double of that when at full light-giving temperature.

19. Specific *heat*, that is the quantity needed to raise unit weight of any substance 1 degree in temperature, *increases* as the temperature approaches the point of a change of physical state, such as fusion. But Siemens, in the course of his experiments on electric pyrometers, found that the increase of resistance by heat is reduced as

the temperature rises, and that the resistance of a metal may be expressed as

$$R = a\sqrt{T} + \beta T + \gamma$$

R being the resistance, T the absolute temperature (reckoned from absolute zero − 273·7° Cent. or − 470·66° Fahr.), and $a\ \beta\ \gamma$ are coefficients related to the particular metals.

Dimensions of Wires.

(20) For electrical purposes, in addition to the ordinary commercial considerations of weight, length, and strength, we must include electric resistance; so that if we fix upon a definite unit, which includes weight, length, and resistance, all considerations are resolved into mere multiples of that unit.

Then, instead of thinking of wires by their mere diameters, we should take into account their sectional area, which is as the square of the diameter. The most convenient basis of practical measurement is the thousandth of an inch now commonly known as a *mil*. Since wires are round, and the areas of circles increase as the squares of the diameters, we should regard the "mil" as a circular wire, and wires generally, not as single cylinders, but as though they were built up of a series of parallel, unit cylinders. Then by squaring the diameter in "mils" of any wire, we obtain direct its area in circular mils—that is to say, the number of unit wires to which it is equivalent. To make the unit complete, its length must be defined, and the foot is the most convenient measure. But as in electricity we require to include in our unit electric resistance as well as the weight, &c., it is still more convenient and generally useful to make weight, rather than diameter, the basis of the unit, and the most generally useful unit would appear to be a wire 1ft. long, weighing 1 grain. By ascertaining the relation of this, for each metal, to the general circular *mil* foot, every necessary calculation can be readily effected. This relation is given as nearly as present knowledge allows in Cols. VI. and VII. of Table I.

Wire Gauges.

21. Wire is usually bought by Birmingham wire gauge; but no one can tell what the Birmingham wire gauge is, and different dealers will differ two or three sizes, while, in the finer wires, it is a mere chance what will be obtained for any gauge asked for. The subject was taken up by a committee of the Society of Telegraphic Engineers and Electricians, whose report will be found in the *Proceedings* of the Society, Vol. VIII., 1879, p. 476. It appears probable that the B W G originated in the sizes resulting from successive draws from the rod of iron, subsequently adjusted to diameters reducing by 8ths, 16ths, 32nds, and 64ths of an inch, and then by 10ths of the 64ths; but makers varied them to suit their purposes, and it is said employed different gauges for paying the workmen or for buying from those used in selling. The committee suggest a new gauge based upon a logarithmic curve, in which each number is 25 per cent. heavier than the next lower: such a curve permits any unit of weight or diameter to be used, and it is proposed to make No. 0 the starting point, with a diameter of 1 centimetre, or inch ·3937, which approximates the average existing values. The following table will show the differences in the gauges:—Col. I. is that of Stubbs and Holtzapffel; II. is that of Messrs. Wynn, and is employed in Culley's work on "Telegraphy," and generally used by electricians; III. is the theoretical original scale, arrived at by the late C. V. Walker, based on 640ths of the inch, and derived from a gauge supplied by Messrs. R. Johnson and Nephew, the well-known wire drawers, with small corrections to fit it to the theory. Col. IV. is the committee's new scale, based upon Latimer Clark's logarithmic curve, and proposed to be called the B.S.G., or British Standard Gauge. The discrepancies increase in the higher numbers, which have been introduced long after the original gauges were established. The best plan is not to go by gauges at all, but adopt either the measured diameter or the weight of a given length, as is always done upon the large scale by electrical engineers.

Table II.—Wire Gauges in Mils.

	I.	II.	III.	IV.		I.	II.	III.	IV.
Gauge.	Stubbs.	Wynn.	Walker.	Clark.	Gauge.	Stubbs.	Wynn.	Walker.	Clark.
000	425·	375·	437·5	492·1	16	65·	65·	62·5	66·1
00	380·	350·	375·	440·2	17	58·	58·	56·3	59·1
0	340·	325·	343·8	393·7	18	49·	50·	50·	52·8
1	300·	303·	312·5	352·1	19	42·	43·	43·8	47·8
2	284·	280·	281·3	315·	20	35·	37·	37·5	42·3
3	259·	258·	250·	281·7	21	32·	32·	34·4	37·8
4	238·	238·	234·4	252·	22	28·	29·	31·3	33·8
5	220·	218·	218·8	225·4	23	25·	26·	28·1	30·2
6	203·	200·	203·1	201·6	24	22·	23·	25·	27·1
7	180·	182·	187·5	180·3	25	20·	21·	23·4	24·2
8	165·	165·	171·9	161·3	26	18·	18·5	21·9	21·6
9	148·	149·	156·3	144·2	27	16·	16·	20·3	19·4
10	134·	134·	140·6	129·	28	14·	14·	18·8	17·3
11	120·	120·	125·	115·4	29	13·	13·	17·2	15·5
12	109·	107·	112·5	103·2	30	12·	12·	15·6	13·9
13	95·	95·	100·	92·3	31	10·	11·	14·1	12·4
14	83	84·	87·5	82·6	32	9·	10·	12·5	11·1
15	72·	73·	75·	73·9	36	4·	7·9	—	—

22. A wire is simply *a cylinder occupying a certain measurement of space*. The weight of the cylinder will depend upon the specific gravity of the material which fills the space.

A *cubic inch of water* weighs 252·456 gr., and this multiplied by 12 and by ·7854 gives us the weight of a circular inch-foot of water; and that multiplied by the specific gravity of any metal gives the weight of a circular inch-foot of that metal, and thus the datum for all required calculations. Taking as the basis, copper = 8·9 the sp. gr. of good copper wire, we find that the circular inch-foot weighs 21176·1 grains, and the logarithm of this 4·3258478 by altering the index to −1 (that is to say, dividing by a million, the number of *mils* to the inch) gives us the weight of the unit mil-foot wire, from which all other information can be calculated. This weight, grain ·0211761 is symbolised, for copper, by M in the formula to be used here. From it we obtain 47·22 as the area of the foot-grain wire in mils, symbolised by G, and the square root of this, 6·872, is its diameter.

23. Assuming as correct the resistance of one foot-grain wire given in Table I., we obtain all that is necessary to complete the data—viz. the resistance of the unit foot-grain wire, which I have calculated at 60° and inserted in column IV. of Table III.

Resistance of soft copper
one foot-grain at 32°, ·2064 −1·3147097
Correction for 28°, 1·0605 .. 0·0255107

Unit resistance at 60°, U. .. −1·3402204 = ·21889

Constants of Unit Wires.

24. Table III. gives the principal constants required for calculations. Those for German silver and brass are for average values, and those of Col. IV. for the grain-foot resistance U ought to be determined for any particular sample if exactness is required. In the case of German silver it may vary 50 per cent., and in that of copper, in proportion to its conductivity.

Table III.—Constants of Unit Wires.

	I. Sp. Gr.	II. M. Grains per *mil*-ft	III. G. Area in *mils* per grain-foot.		IV. U. Resistance at 60° Fahr. of foot-grain.	
			Mils.	Log.	Ohms.	Log.
Water	1·	·0023793	420·29	2·6235422		
Copper ..	8·9	·0211761	47·22	1·6741522	·2189	−1·3402204
Iron	7·8	·0185590	53·88	1·7314476	1·1634	0·0657173
German silver ...	8·7	·0207003	48·31	1·6840229	2·6699	0·4234939
Brass	8·4	·0199865	50·03	1·6992629	·9938	−1·9972763
Platinum..	21·4	·051006	19·61	1·2923782	2·8879	0·4760559
Carbon ...	1·6	·003807	262·68	2·4194222	95·592	1·9802392

Formulæ for Wires.

25. As the following formulæ differ in several points from those generally given to attain the same results, it may be explained that this is owing to the definite system of which these form a part. Most other formulæ are single ones, devised each for its own purpose, and often based upon mere actual measures of particular wires, which often vary in quality. Those given here may have no actual superiority over these others, except as forming part of a definite system based upon mathematical truths, and linked especially to the conception of wires, not as each separate entities, but as consisting of collections of unit wires of definite property, thus giving to d^2 an extended meaning, from the mere square of the diameter of single wires to the number of units in all wires.

Symbols Used in the Formulæ.

26. Let the following letters represent the requisite particulars.

W = weight in grains. $W \div 7000$ = weight in pounds.
w = ditto per foot. = $M \times d^2$ or $d^2 \div G$.
M = ditto per mil-foot = $m \times s$ or $1 \div G$ or $U \div u$.
m = ditto ditto of water = ·0023793 Log. −3·3764578.
d = diameter in mils (inch ·001) = square root of d^2.
d^2 = square of diameter = area in circular mils = $w \times G$.
G = area in mils of the grain-foot = $1 \div M$ or $u \div U$
g = ditto ditto of water = 420·29 Log. 2·6235422.
l = length in feet.
s = specific gravity. = $M \div m$ or $U \div (u \times m)$.
R = resistance in ohms at 60° Fahr. $U \times l \div W$.
r = ditto per foot = $R \div l$.
U = ditto ditto of the grain-foot = $r \times w$.
u = ditto ditto of the mil-foot = $U \times G$ or see $\mathcal{R}$.
$\mathcal{R}$ = specific resistance of cub. cent. ohm = $u \times$ 0000016624 Log. −7·2207291. ditto for microhms use index −1·; for C G S units 2.
$\mathcal{R} \times$ reciprocal of these constants gives u.
$s \times m$ gives all the data for weight &c., so that from these two data all requisite information can be calculated.

27. In working out any examples I shall use logarithms, because they are really the simplest of all modes of calculation except the slide-rule, which is, in fact, a logarithm machine. Every one should learn to use them, if only for the sake of extracting square and cube roots which only requires the division of the logarithm by 2 or 3.

The whole system of calculation for wires is really contained in §§ 26; but as it would be too concise for unpractised readers, I will explain in more detail, with examples in my next paper.

PRACTICAL NOTES ON PLUMBING.—LXXIX.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 595, *Vol. XXXVII.*)

Rams Without Air Chambers.

NEXT examine Fig. 375. This, another of Blake's rams, is made to work without the use of the air chamber, a plunger, E, being substituted in its stead, which is held down by the springs H H, and the cross-lever J. It will be plain that when the ram is put into action, that as the water rises from the body of the ram into the pipe D and R, that at every pulse which the foot valve C makes, the momentum of the water will be felt upon the bottom of the piston E, and which will cause the piston to jig or rise with a spring at each stroke of the ram. It also follows that the piston E must rise in its cylinder according to the pressure upon its lowe arrest the column of water, the weight of the water in the trunk A will tend to create a partial vacuum; and in proportion to the velocity and weight of the water, so will the diaphragm G move inwards, and so work the lever H, which being jointed at J with the short slotted lever K, will raise the pump piston L, when the effect of the momentum of the water within the trunk is past, so will the weight I bring back the lever H, and with it the diaphragm, and so on alternately, and it will be plain that by this method water may be raised to any height required. This diaphragm arrangement may be made to give an outward thrust instead of an inward action, and may be fixed at B W, Fig. 376.

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Rams with Double-Foot Valves.

FIG. 379.

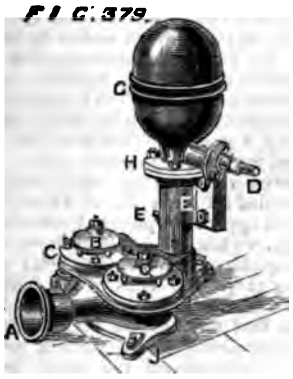
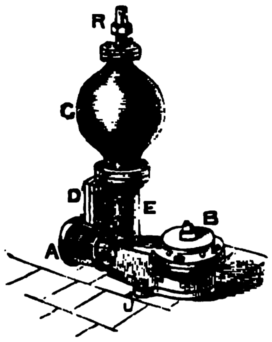


FIG. 380.



This kind of ram is illustrated at Fig. 379. The parts are as follows:—A is the socket for receiving the spigot end of the trunk, C the flange for fixing the valve plate over the body, B O are the beat valves, D the outlet or rising main, and G the air-chamber. Fig. 380 is a side elevation of a ram, having the rising main coming off the top of the air chamber; D is a door or plate for examining the interior parts of the ram.

Having described and explained the different rams and their action, I will proceed to show one or two fixed, and to describe the modes of fixing, &c. I may first mention that water rams, like all other engines, cannot do work of their own accord, but will be dependent upon some of the prime moving elements, let the power come from where it may. Therefore, the useful effect of this apparatus will be governed by a certain force, generated in this case by a running stream or head of water, and determinable by the well-known laws of mechanics. The simplicity of the operation of this machine has been the means of its ranking as one of the most beautiful philosophic instruments which has hitherto figured in the pages of any writer on natural philosophy and hydraulics; and its durability and simplicity render it one of the most important and valuable self-acting machines yet developed. This hydraulic machine is especially useful for forcing water where large quantities can be allowed to run to waste.

(*To be continued.*)

COMBINED WHEEL AND LEVER BACK CENTRE.

THIS combination has been invented to prevent the loss of time, expense, and trouble experienced by workmen in substituting a wheel centre for a lever centre, or the reverse, the necessity for which, in all classes of work, is daily, in some trades hourly, experienced. The result has been obtained without resorting to any complications of mechanism, and its great superiority over the old type is thus secured without additional cost. It involves no additional cost, though double the convenience of two centres: is equally effective either with lever or wheel; no time is wasted in substituting one form for the other, and it can be used as a self-acting gauge, insuring accuracy in work. Fig. 1 shows back centre in use with lever. . Fig. 2 shows back centre in use with wheel. To use the back centre with a wheel, place the loose pin A in the hole B, and throw the lever back out of the way. To use the back centre with lever, place the loose pin A in the hole C, thus securing the lever in place. Either change can be effected in two seconds. The sole patentees and manufacturers are Messrs. T. B. Barker and Co., of the Universal Gas Engine Works, Scholefield-street, Birmingham.

FIG. 1.

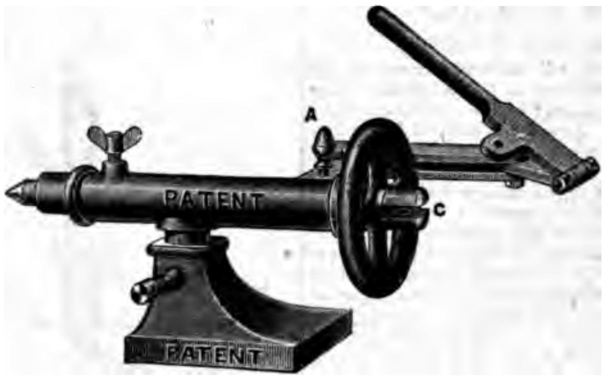
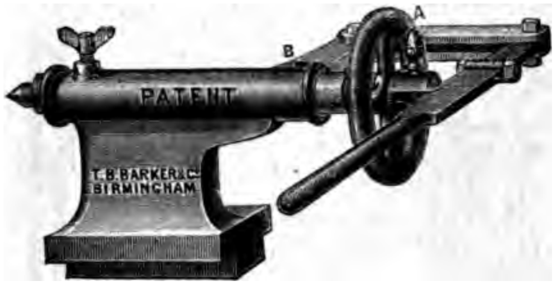


FIG. 2.



RAISING, LOWERING, AND SECURING SHIPS' BOATS.

A SIMPLE but apparently very efficient apparatus for lifting and securing ships' boats has been recently patented by Messrs Harland, Wolff, Wilson, and Pirrie, of Queen's Island, Ireland. The first two names will be recognised as those of the celebrated firm of shipbuilders, and we may take it that they are thoroughly satisfied as to the merits of the invention, the chief object of which is to enable the largest boats to be got outboard by a few hands instead of the large number now generally necessary. The improvements may be carried out by various arrangements of levers, wedges, cams and other mechanical appliances, but the patentees prefer the following arrangement shown in detail in Figs. 1, 2, and 3.

Below the bottom of the boat, when it is resting upon the chocks, are two shafts at a distance apart from one another, and at right angles to the keel. The shafts turn in brackets bolted to the dock or platform on which the boat is carried. Each axis has standing out from it two short arms A, carrying between them a roller B which comes just below the boat's keel, when the boat is in its place upon the chocks. The outer end of each axis has a socket standing out radially from it, into which a long bar can be inserted. When the boat is resting upon the chocks, the short lever arms are horizontal or nearly so. When the axis is turned by the bar, so as to cause the roller at the end of the short lever arms to lift the boat, a little more than a quarter turn is given to the axis, whereby the short lever arms are moved somewhat beyond a vertical position, as indicated by the dotted lines in Fig. 1 so that the weight of the boat has then no tendency to turn the levers back again in the opposite direction. The boat can in this way be lifted at each end, say about six inches, thus freeing the outside chock, which can then be tumbled over, and the slack of the falls taken in and secured, the levers are then partially reversed to free the boat's keel, and the boat swung out. The roller at one end has a flange D round its end furthest from the vessel's side: this enables the boat's keel to be readily placed upon the rollers when they are raised and ready to receive the boat when being swung into place. When the boat is being lowered, the jaws C on the two arms which carry the roller come one on either side of the keel. In this way the keel of the boat on being lowered on the rollers is readily caught, held laterally, and guided into the fixed blocks at each end by the jaws C, and then lowered into its place by the reverse action of the levers, while the weight

Fig. 1

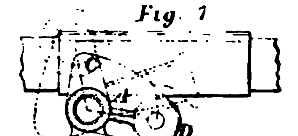


Fig. 2

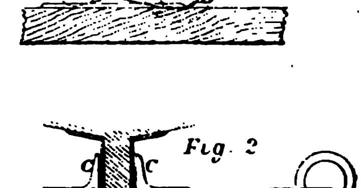
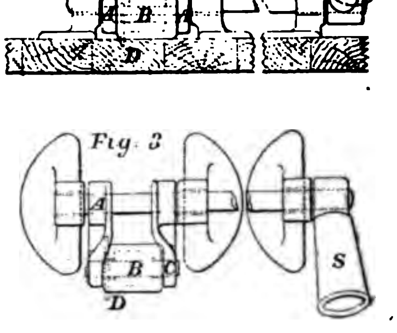


Fig. 3



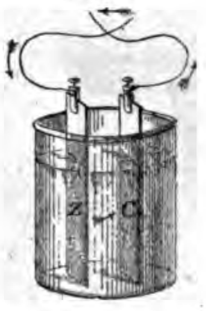
of the boat is borne by the rollers. The castings holding the rollers are constructed with a stop resting on the deck, and the centres arranged in such manner that when the bars or handles are pulled over to the full extent, they cannot be thrown back by a weight on the rollers.

THE DYNAMO: HOW MADE AND HOW USED.—III.*

By Selimo R. Bottone.

§ 4. THE student will do well to compare the effects produced on the galvanometer by the battery current, and by the current obtained from the magnet. Any single cell will do for this purpose; and in order to have an intelligent perception of what takes place, the student must bear in mind, that *in* the battery itself, the electricity (undulatory movement of the molecules) passes from the zinc to the negative plate (be it copper, silver, platinum, or graphite), while *outside* the battery, the electricity passes from this latter round through the wires, galvanometer, or other circuit open to its passage, back again to the zinc plate (See Fig. 4, where the direction of the undulation, or "current" is shown by the arrows; the plate marked Z being zinc, the one marked C being carbon, copper, or other conductor; W W being the wires forming the *poles* or *electrodes*). If the positive pole (the one from which the "current" is flowing: the wire attached to the C plate) of such a battery be connected to the galvanometer by means of the binding screw marked "over," the other pole being attached to the other binding screw, the north pole of the needle having previously been adjusted so as to lie between the two binding screws, it will be found that the N. pole of the needle will deflect to the *left* of the line of the coil; the operator being supposed to be standing at the binding-screw end of the galvanometer. Since the wire of our coil returns *below* the needle, it is evident that a positive current (an outflow of undulation) passing *over* the north pole of a horizontally suspended needle, or a negative current (an influx of undulation) passing *under* such a north pole, causes it to deflect to the *left*.

Fig. 4.



If we disconnect the battery, and reverse the connections, *id est*, join the negative pole (the wire coming from the zinc) to the binding screw marked "over," the other pole being connected to the other screw, the opposite effect results—viz., the north pole now deflects to the *right* of the coil. This will be understood by reference to Fig. 5, in which *a* represents the effect of the positive current flowing *from* the operator *over* the needle, the N. pole in both illustrations being nearest to him; in *b* the positive current is supposed to be flowing *from* the operator, *below* the needle, in either case returning to the battery the opposite way.

§ 5. This effect will enable us at once to recognise, by means of our galvanometer, the *direction* in which a current is travelling; for, on connecting the two terminals of any source of electricity to the binding screws of the galvanometer, whilst the N. pole is in a line with the coils, between the two binding screws, the operator facing the north pole of the needle, it is evident that if the N. pole of the needle is deflected to the *left*, the terminal attached to the binding screw marked "over" is *positive*; but that, if the N. pole deflects to the *right*, then the said terminal is *negative*. It must be borne in mind that by the term *positive* in this connection is meant the point *from* which electricity is flowing, negative being the point *towards* which it is flowing, or *at* which it enters.* This power of recognising the direction of a current will be found of great service to us in the construction of the dynamo.

§ 6. Returning now to our experiments with the magnet (see latter portion of § 3), and using in preference a straight soft iron rod, about 6in. in length, and ½in. in diameter, coiled with about 100ft. of No. 24 covered wire as our armature, and a good bar magnet to produce the electrical effects, we shall find, on coupling up the armature wires to the galvanometer, and approaching one end of the armature to or receding it from the N. pole of the magnet, that the electrical flow set up is always in one direction in approaching or making contact, and in the opposite direction on receding or breaking contact. Fig. 6 will make this clear. The arrow at *a* shows the direction of the current produced on approaching or making contact with the N. pole of a magnet; *b* illustrates the direction of current produced on receding from or breaking contact with the N. pole of a magnet. If now we reverse the experiment by presenting the S. pole of the magnet to the coiled armature, we shall find that the direction of flow is also reversed; that is to say, the *withdrawal* of a south pole produces the same effect as the *approach* of a north pole, and *vice versâ*, the *approach* of a south pole is equivalent in its effects to the *recession* of a north pole. It must be noted that the direction in which the wire is coiled round the soft iron rod (or armature), while it has no influence on the direction of the electrical current set up round the iron rod (which is always the *reverse* to the hands of a clock in the face *approaching* the north pole) determines the extremity of the said wire at which the current leaves or enters the coil. In the figure we have supposed the wire to be wound from *left* OVER towards *right*; had we wound our rod from *left* UNDER towards *right*, the opposite ends of the wire would have been respectively + and —. This must be borne in mind when we proceed to actual work.

Fig. 5.

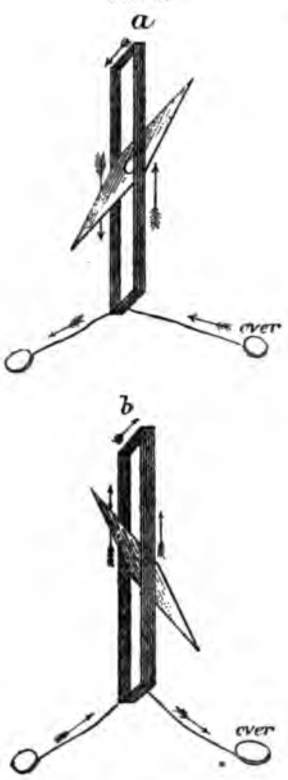
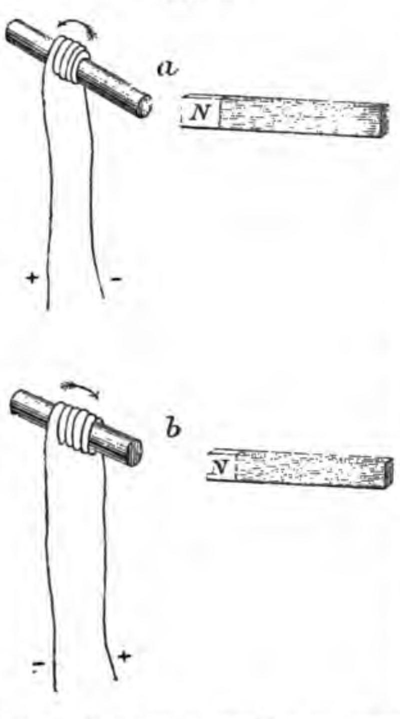


Fig. 6.



§ 7. *Currents can produce Magnetism.*—If we take the coiled soft-iron U, of which we made use § 3, and apply it to pieces of soft iron, nails, filings, &c., we shall find that it possesses little or no magnetic power of attraction; but if we couple the projecting ends of the coiled wires one to each terminal of a single-cell battery, we shall find that the U will become powerfully magnetic, retaining its magnetism as long as electricity flows around the coils, but losing nearly all the instant that the flow is caused to cease, either by breaking connection with the battery, or by any other interruption. The rapidity and completeness with which the iron loses its magnetism depends almost entirely on its *softness* and *purity*. Anything which tends to put a strain on the molecules of the iron, such as hammering, filing, twisting, sudden cooling, vibration, &c., render it liable to retain magnetism, or increase its *coercitive* force: whereas raising to a high temperature and very gradual cooling, which allows the molecules to range themselves with little or no strain, furnishes a soft iron, eminently incapable of retaining magnetism, or possessing little *coercitive* force.

PATTERN MAKING.—XIV.

(*Continued from page* 594, *Vol. XXXVII.*)

Flywheels and Strap Pulleys

ARE made by similar methods, and permit of very little variation in design. We may divide them into two classes simply—those with cast, and those with wrought iron arms. The former are the more rigid, the latter are the safer.

Taking flywheels first in order, we shall find that except in the case of standard wheels made for engines which are a speciality, and which, therefore, require a repetition of castings all exactly alike, very few flywheels are made from patterns: but are struck up. If, however, we had to make a pattern for one of these standard wheels, or even for a small engine of one or two horse-power or less, we should proceed as follows:—

Build up the rim in courses of segments, as in the case of a toothed wheel, p. 143, and lock the arms together, according to directions also previously given, p. 191. When the rim is built up to half its full thickness *plus* half the thickness of an arm, turn its inner portion to the correct diameter, and notch out recesses to receive the ends of the arms. Glue these in, and above them glue on the remaining courses of segments. Then complete the turning of the rim, and work the arms to shape. (Fig. 63.) If the wheel were large it would be more convenient to work the arms, before glueing them in place, leaving only the radii which merge into the rim to be finished in position. Suitable bosses will then be turned and screwed on the centre of the wheel, and the core print put on the centre of the one in the down side of the mould.

But suppose we have to make a large wheel, ranging anywhere between 3ft. and 12ft. in diameter. We should proceed in this way. W

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* *All rights reserved.*

* We have no desire to enter into any theoretical matters in these papers; but comparing electricity to sound, we may say that in blowing a blast in a trumpet, the trumpet may be considered as *positive*, while the ear of the listener may be considered as being negative. The chief difference seems to be that electrical undulations seem to require a complete circuit wherein to display their effects, sound undulations being bound by no such conditions.

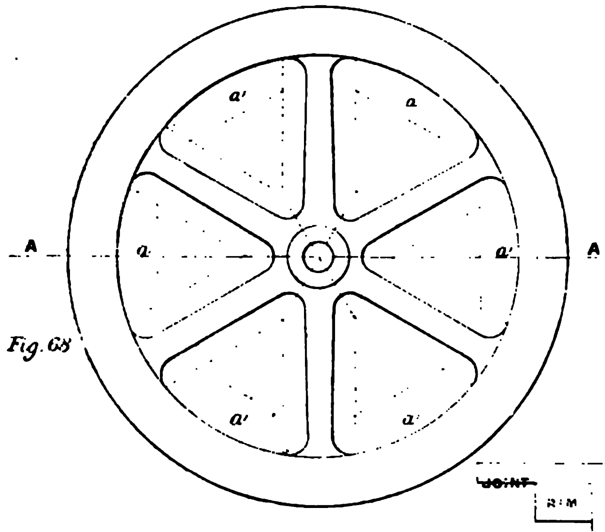


Fig. 68

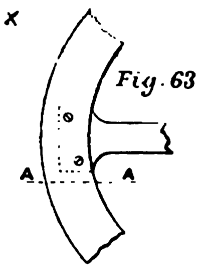
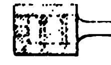


Fig. 63

SECTION A A



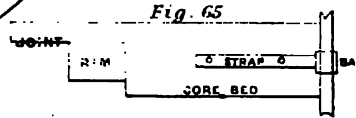


Fig. 65

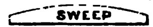


Fig. 64

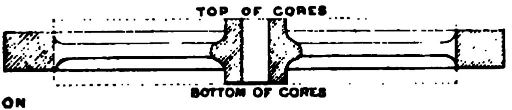
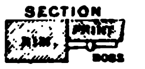


Fig 68 SECTION A A

SECTION



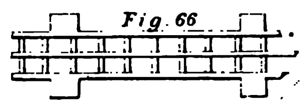


Fig. 66

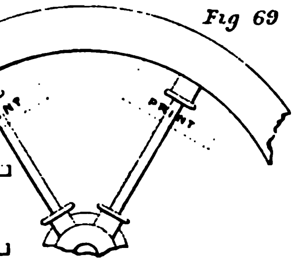


Fig 69

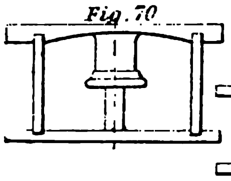


Fig. 70

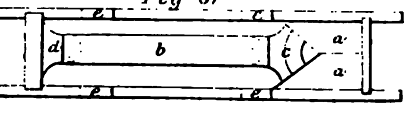


Fig 67

should make a board chamfered like a loam board, and, like it, fastened to a centre bar, to strike a ring of sand of the same diameter as the periphery of the wheel, the top edge of which ring would be struck off level by the board to form the joint for the top of the mould. The disc inclosed by this ring would be struck to a true plane of sand at a depth below the joint equal to the thickness of the wheel rim. During the process of striking, the sand forming the outside of the rim will break away and fall down to a certain extent. A sweeped piece, worked to the proper radius and depth, will therefore be necessary to mend this up smooth and sharp. (Fig. 64.) Further, if the flywheel be shallow, the striking board must be modified a little. From the inner diameter of the ring right away to the centre it must be cut deeper by 2in. or 3in., thus recessing the bed below the edge of the rim by that amount, Fig. 65. The object of this is to get sufficient depth of sand and grid room in the cores which are to form the arms. There should not be less than 1½in. or 2in. for sand, and 1in. for grid allowed over the thickest part of the arm.

Two cores, placed face to face, make up an arm. They are jointed in the circular plane of the wheel, and extend from the inner diameter of the rim to the central boss. If, then, our bed were level with the edge of the rim, our corebox would be just half the depth of the rim. If the corebed were sunk lower than that edge, the corebox would be thicker by that amount than half the depth of the rim.

To make it, it must be sufficiently wide to give 3in. or 4in. in breadth of sand for jointing where the cores abut against each other around the boss. There should also be enough sand to include the radii or hollows where the arms sweep into the rim. It will be framed together in the usual fashion of rectangular coreboxes, with two sides, Fig. 66, having their two ends kept in position by shallow grooves. The end, which represents the inner diameter of the wheel, will be hollowed to the same sweep as that diameter. At the opposite or boss end, two symmetrically-shaped joint blocks, *a a*, will be fitted, including between them an angle of 60°, that being the angle which the cores will occupy in relation to each other in the mould for a six-armed wheel. On one edge of the box so made, a bottom board will be dowelled.

We have now our box in outline, requiring the arm to complete it. As our cores are to be jointed in the centre, both top and bottom cores are evidently to be alike, and our arm will represent only a *half* section.

Get out three pieces of wood, representing respectively the straight portion of the arm, *b*—the sixth part of the boss including the hollow by which it sweeps into the straight arm, *c*, and the sweep curving into the rim *d*, each in half section. Dowel or screw these in the centre of the corebox on its bottom board. A sixth part also of the core print may be put on the boss segment, if the box be deep enough to allow of this, or the core may be centred in the mould after the cores are laid in place. Notches, *e e*, will be cut out on the top edges of the core box to take the grids, Fig. 67. A grid is a cast-iron frame of latticework, which the moulder uses for the same purpose as the bricks and plates in a loam mould—viz., to give rigidity to the core. Those portions of the grid which project beyond the core are in this case also used for the purpose of screwing the top and bottom cores together before casting.

The cores, when made, are dried, blacked, jointed, and laid in the mould, as indicated by the dotted lines in Fig. 68. There will then be open spaces *a* between each double core, which must be filled up to form that portion of the rim not already formed by the sweeped ends of the arm cores. These intervals may be filled up either by distinct cores, involving a box, or by a sweep against which the moulder will ram green sand, similar to the one used for mending up the outer sand, but cut in the opposite way—viz., hollow, and of the same radius as that of the inner part of the rim.

Then there remains the top of the mould. This is struck by a board, and in loam generally, sometimes, however, in green sand—viz., ordinary moulding sand. If in loam, it is struck on a circular cast-iron plate, roughened over as usual to hold the loam; if in green sand, a top part box will be used. If the cores are deeper than the rim, as in Fig. 68, the board will be shouldered as in the bottom; in fact, the same board will suffice for striking both the top and bottom. This completes the wheel as far as the pattern maker is concerned.

But in wheels running at high speeds people have learned to distrust cast iron, and though the massive rim is still retained, it is preferable to make the arms of wrought iron. In wheels made entirely of cast iron the disproportion between the heavy rim and the comparatively slight arms sets up initial strains within the casting, which become a perpetual source of insecurity. Hence reason and experience have decided against the use of such wheels for quick-running machinery, and in favour of those with wrought-iron arms. The strength of these also must bear a proper relation to the momentum of the wheel, else they will twist off close to the boss, as I have seen in more than one instance.

To make such a wheel, quite a different mode of procedure must be adopted to that just described. In the first place we shall make the rim in another way, though still without a complete pattern. We shall have no board, but a sweep of exactly the same section as the wheel rim, and a foot or two longer (according to the size of the wheel) than the sixth part of its circumference (Fig. 69.) Exactly one-sixth part of the inner circumference of the wheel (= its radius) will be marked on the inner edge of this sweep, and on the centres so marked prints and half bosses for the reception of the arms will be fastened.

Then the sweep with its bosses and prints is rammed up level with its top face, and drawn from the sand. It is then carried round exactly one-sixth of its circumference, and its right hand print and boss is dropped into the impression just made by its left-hand print and boss. There the sweep is again rammed up, to be again withdrawn and removed, until the ring, with its six bosses and six prints, is complete. The reason why prints are used is obvious on a moment's consideration. The wheel being moulded in segments renders it impossible to ram up a top part in place, as in the case of a pattern, and, as a consequence, the only possible way of making the top half of the boss is by a core.

The corebox will consist of a rectangular frame having one side sweeped to the inner curve of the rim, and a bottom board on which will be fastened the half boss and print. (Fig. 70, enlarged for distinctness.) These must be exactly in the centre of the box, and of exactly the same shape and size as those which are fastened on the rectangular print; otherwise there will be overlapping of joints in the casting. In fact we always joint the two halves and turn them together; then, taking them apart, use one for the corebox, the other for the pattern. The print in the boss is of the same diameter as the wrought-iron arms, and that part of the arm which enters the boss is jagged or notched in order that the cast iron may embrace it the more securely.

The mould for the rim having been completed, the arms are laid in the prints ready for their reception, the rectangular cores are laid over their ends (each in its print), and the entire ring is covered with a flat surface of loam or green sand. The rim is then cast and allowed to cool. When cool, but *not quite cold*, the boss will be cast on the other ends of the arms, which also will be notched to prevent possible loosening.

The reason why the boss is cast on after the ring has cooled, is that the contraction of the ring in cooling is so largely in excess of that of the boss, that the rigidity of the latter, by preventing the arms from coming inwards, would infallibly either bend the arms or fracture the rim. Hence the boss is always cast when the rim has nearly, but not quite, done contracting, there being, of course, a slight amount of shrinkage on the boss.

A complete pattern boss is wanted jointed in the centre of the arm bosses in a direction parallel with the plane of the wheel. The boss mould, also, is made in halves, and usually dried.

(*To be continued.*)

PROF. KLINKERFUES' IMPROVED HYGROMETER.

An improved construction of hygrometer has been recently patented in this country on behalf of Professor Klinkerfues, director of the Göttingen Observatory. The invention relates to hair hygrometers, and is also applicable to other instruments in which the hygroscopic qualities of the human hair are employed for indicating the relative moisture of the atmospheric air in combination with air pressure and temperature of air. As a hair or a hair-string, of quality and preparation as used for hygrometers or weather instruments generally, changes its length not in geometrical proportion to the changes of relative moisture of the air, and as [illegible]

FIG. 1.

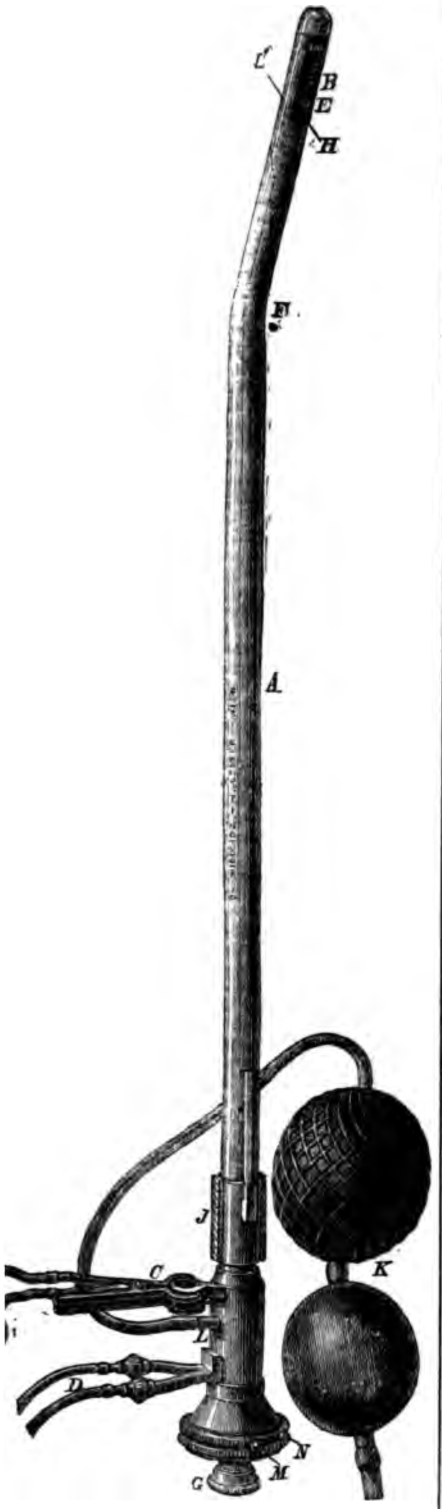
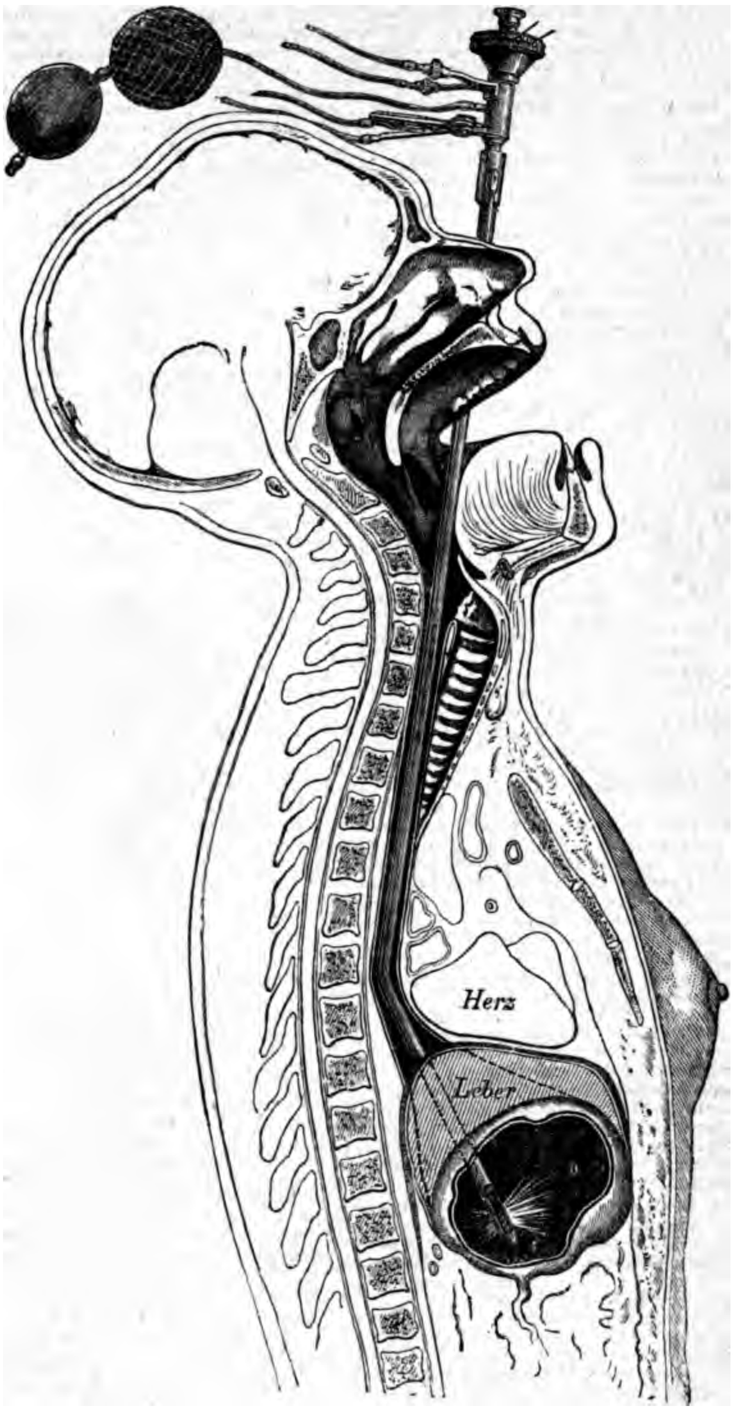


FIG. 2.



the part examined, the image being received by eyepiece either direct or, where necessary, er being diverted in the proper direction through sms.

.eiter's original gastroscope in particular was a rvel of ingenuity in the various arrangements allowing the walls of the stomach to be ıminated and examined by the aid of lenses, but apparently been found too complicated for .ctical use, and a simplified form is described by . J. Mikulicz (with a great elaboration of ail on all points), which has been devised by n in collaboration with Herr Leiter.

The tube A (Fig. 1) is 65 cm. long and 14mm. ck, and is bent at F at an angle of 150°. At B is platinum wire for the electric light covered with lass plate and connected, by wires running up tube, with the key C and a Bunsen battery. o water-tubes also run up the main tube, their ls being shown at D, a constant stream of water ng maintained during the observation so as to vent the lower end of the tube becoming heated. ere is an additional tube for pumping water into stomach, which commencing at the indiarubber ls K passes into the main tube at L and is conted-to L' where there is a small aperture.

The optical apparatus consists of a prism and an objective at E (the prism being right-angled and acting as a reflector to transmit the rays from the side of the instrument up the tube), a second prism at the bend at F, and an eyepiece at G. To prevent the glass plate at B from being smeared whilst the instrument is passed down the œsophagus a metal shutter H slides over it, and can be drawn back by moving the collar at J.

The fact is enforced in italics that the instrument can be introduced into the bottom of the stomach without difficulty, and Fig. 2 is given in illustration of the statement; another figure showing the advantage of the bent end in allowing different parts to be illuminated and observed by simply rotating the tube, the stomach being distended to facilitate the excursions of the tube. The authors' pamphlet contains not only a very full description of the instrument, but minute directions for its use.

Dr. T. Oliver describes a successful experiment of examining the interior of a patient's liver by one of the small Swan incandescent lamps described by Mr. Stearn. The apparatus used was an electroplated brass tube 9½in. by 11-16ths inch, closed at the lower end by glass, down which was inserted a narrow cylinder carrying a lamp and wires. Mr. J. B. Payne (a Fellow of the R. M. Society), who devised the arrangement, considers it to be much simpler than Leiter's platinum wire, as it gives a perfectly pure light and develops less heat. He says "a Swan's electric lamp is used—the filament of which is carbon, and rendered incandescent by means of battery power. It is hermetically sealed in a glass shade; and water, conveyed to and fro through very small brass tubes, is made to circulate round the lamp. The light from this lamp is perfectly pure, and exhibits the condition of things in their true and natural colour. For prolonged observation I should prefer to use either a Grove's or Bunsen's battery, but in the demonstration just referred to, four cells of a modified Leclanché battery were employed and answered admirably. It is advisable to have as great a pressure as possible for the water supply, so as to insure perfect circulation, and for this I suspended from a hook fixed near the ceiling of the room a tin can containing water, connecting it with the brass tubes by means of lengths of indiarubber tubing."

BERTHELOT ON EXPLOSIVES.—IV.

BETWEEN these two limits there is observed an entire series of intermediate stages of an unlimited number, as is shown by the different methods of burning of dynamite, and the influence of tamping which allows the transformation from burning into a real detonation, if the tamping is sufficiently resisting. Finally we may cite the inequality of the effects produced by the successive explosions of the charges of the same agent, which [illegible] by influence within limited distances beyond which the explosion will not propagate [illegible]. We [illegible] refer to chemical phenomena. That [illegible] decomposition prevails when the explosive substance contains sufficient oxygen to experience a complete combustion as occurs for nitro-glycerine and [illegible], besides it is necessary that this total combustion shall have actually taken place, which does not necessarily happen, especially [illegible] performed at a temperature as low as possible. But it often happens that the oxygen is insufficient, or that the first reaction gives rise to a wasteful expenditure of this oxygen as is the case when nitro-glycerine burns slowly, with the production of nitrous vapours and of fixed or gaseous substances incompletely burned. Under these circumstances the possible decompositions are numerous [illegible] their number depends on the temperature, on the pressure, and on the rapidity of the heating. We have already remarked upon this in the case of ammonium nitrate; it may be observed in general in organic substances, decomposed by heating.

Among these decompositions those which develop the most heat are those which produce the most violent explosive effects, other conditions being equal. This fact is evident when the volume of gas produced [illegible] remains in the same [illegible]. But it is also verified in [illegible] the decomposition giving rise always to a maximum of pressure, as I have shown elsewhere. In the other hand this fact does not obtain as a general thing in reactions which are produced at the lowest possible temperature. If then, the [illegible] produces in a given time a quantity of heat sufficient to carry the temperature up to [illegible] degree which corresponds to the most violent [illegible] decomposition capable of giving [illegible] heat, and [illegible] completely by this [illegible] these explosive effects [illegible]. The opposite will [illegible] tended to the [illegible] energetic [illegible].

Finally the multiplicity of the possible reactions [illegible] intermediate effects, and [illegible] according to the [illegible] by M. [illegible]

time, into the midst of the first layers of the explosive substance reached by the shock.

The phenomena which we have described have had reference to solid or liquid explosives, but the gaseous compounds and the detonating mixtures of gases give similar results, these throw a still greater light on the theory. In reality the chemical transformation of such a gaseous mixture may act with very different rapidities according to the mode of propagation of the decomposition or of the burning. Let us begin with a compressed gas formed with the absorption of heat according to its elements, such as hypochlorous acid ($Cl + O = ClO$ absorbs − 7·6), acetylene ($C_4 + H_2 = C_4H_2$ absorbs − 61·5) or cyanogen ($C_4 + N_2 = C_4N_2$ − 74·5). Such a gas is decomposed in inverse proportion to the liberation of heat. This, for instance, is what we obtained with the hypochlorous gas, heated below 100°C or traversed by an electric spark, or placed in contact with a body in ignition; the gas detonates at once, reproducing chlorine and oxygen. But it is not the same with acetyline nor with cyanogen. These gases neither detonate by the influence of heating nor by the influence of the electric spark, although they are decomposed by them, little by little, and without exploding. On the other hand, I have found that a quick shock of mercury fulminate will cause them to detonate rapidly with considerable flame, separation of their elements, carbon and hydrogen in the case of acetylene, and carbon and nitrogen in the case of cyanogen. The experiments have recently been described in the present work.

The explosive mixtures formed by the union of oxygen with a combustible gas may also burn with extremely varying rapidities, according to the method of the propagation of the chemical reaction. We have cited the experiments of M. Bunsen, who thought it possible to fix the rapidities of combustion of a mixture of hydrogen and oxygen gas, in equivalent proportions, at 34 metres per second, and that of a mixture of carbon monoxide and oxygen at only a metre. These are experiments based on the retrogradation of the flame back into the mixture, while flowing out into the atmosphere through a narrow opening. Having recently undertaken these experiments with M. Violle under different conditions, we have observed rapidities incomparably greater. Our method of operation was as follows: On each occasion we filled under atmospheric pressure with an explosive mixture, an iron tube 5 metres long, having an internal diameter equal to 5mm., capable of being sometimes kept open and sometimes closed at its extremities, or else a lead tube 40 metres in length, or sometimes a thick indiarubber tube 40 metres long. By means of a special arrangement we are able to register the passage of the explosive wave, first at the beginning of the tube, then further on, and finally at the end of the tube, and also we were able to measure the time elapsing between these different passages. These experiments were made with the tubes which were sometimes opened at one extremity and sometimes closed; on some occasions they were placed horizontally, and on others they were arranged vertically, and under different pressures. They had proved to us that the detonation is propagated with a rapidity equal to thousands of metres per second, as well for the mixture of hydrogen and oxygen as for the mixture of carbon monoxide and oxygen.

The difference between these results and those which were obtained by M. Bunsen may be explained by the variance in conditions. The gases burned in the earlier experiments were cooled by contact with the air, and the explosive wave not produced. The difference between the two kinds of combustion appeared analogous to that which exists between the simple burning of explosive substances—an operation in which the movement of the different particles takes place confusedly and in an independent manner, and their sudden detonation, provoked by a fulminating cap, an operation in which the movements become co-ordinated. Hence the effects of temperature and of pressure attain their maximum, and are propagated with an incomparably greater rapidity. Some of these experiments made with the fire-damp of mines [illegible] an analogous interpretation.

So far we have regarded the development of the explosive reactions either from the point of [illegible] in a homogeneous system [illegible] parts are maintained at the same [illegible] from the standpoint of their propagation in a system equally homogeneous, to [illegible] directly by means of a body in [illegible] a violent shock. In these last [illegible] the study of explosive substances [illegible] the existence of another method of [illegible] the reactions in an explosive centre, propagating the reactions taking place at a distance and by the propagation [illegible] of the air or certain solid bodies [illegible] participate in the chemical [illegible]. We now wish to speak of what are called [illegible], whose existence was [illegible] by [illegible] from certain known facts relative [illegible] explosion of several buildings [illegible] considerable space from each other, as in catastrophes occurring in powder mills. Attention has been specially directed to this class of phenomena by the study of nitro-glycerine and gun-cotton.

We will begin by giving the most important characteristic facts. A dynamite cartridge made to detonate by means of a fulminate cap causes the adjoining cartridges to detonate, not only by contact and by direct shock, but even from a distance. In this way an indefinite number of cartridges, arranged in a regular course, may be made to detonate. The distances to which the explosion may be propagated are relatively great. Thus, for instance, cartridges being contained in rigid metallic envelopes and placed on a resisting soil, the detonation produced by 100 grains of Vonges' dynamite (75 per cent. nitro-glycerine, 25 per cent. randanite, that is to say, very finely divided silica) communicates itself 0·3 metres of distance, according to the experiments of Captain Coville. D being equal to the distance in metres, and C the weight of the charge in kilograms, the experiments of this officer show that D = 3·0 C. When the caps were laid on a rail, D was found to be equal to 7·0 C. On soft or ploughed up earth the distances, on the contrary, are less. When a cartridge is suspended in air there is no detonation by influence, perhaps because the cartridge not being fixed can recoil freely, which diminishes the violence of the shock. Nevertheless, there are experiments which show that the air suffices for the transmission of the detonation by influence, although with greater difficulty and requiring a greater mass of the explosive. With a dynamite less powerful in nitro-glycerine (55 per cent. of nitro-glycerine and 45 per cent. of the argillaceous ashes of boghead coal), contained in similar cartridges, and placed along the ground, the experiments of Captain Pamard have given the smallest distances: D = 0·90c. If metallic envelopes having less resistance are used, the distance at which the explosion is propagated is likewise diminished. Dynamite simply spread along the ground ceases to propagate the explosion. The experiments performed in Austria have given similar results. They have shown that the explosion is communicated either in the free air with intervals of 4cm., or else through pine boards 18mm. thick. In a lead tube with a diameter = 0·15 metres and a metre in length, a cartridge that is placed at one extremity has caused the detonation of a cartridge at the other end. The explosion is still better transmitted through tubes made with wrought iron. Couplings of the tube diminish their aptitude for transmission. An explosion which is propagated in this matter will go on weakening itself from cartridge to cartridge, and even change its character. Thus, according to the experiments made by Captain Müntz at Versailles, in 1872, a first charge of dynamite, exploded directly, excavated a funnel-shaped hole in the ground with a radius of 0·30 metres: the second charge, detonated by influence, produced an opening of only 0·22 metres: the effect of the detonation was then reduced. This reduction should manifest itself towards the limit of the distance at which the influence ceases. In the same way four tin sieves were taken and located at 40mm. apart, and against each of them a small cylinder of gun-cotton was placed and the entire affair arranged on a board; 15mm. in front of the first sieve a similar cylinder was detonated. All of the cylinders detonated, but a progressive diminution was observed in the excavations produced in the board below each cylinder. According to these facts, the propagation by influence depends at the same time on the pressure acquired by the gas, and on the nature of the support. It is not even necessary that it should be rigid.

Finally, in operating under water at a depth of 1·30 metre, a charge of 5 kilograms of dynamite brought on an explosion of a charge of 4 kilograms, situated at a distance of 3 metres. The water then transmits the explosive shock, at least to a certain distance, as does a solid body. This transmission is so violent that the fish are killed in ponds without the sphere of a certain radius by the explosion of a dynamite cartridge.

(*To be continued.*)

MOUNTING PRINTS.

UNTIL improvements in photo-mechanical printing methods enable us to economically and conveniently impress the photographic image directly upon cardboard, the work of mounting prints will form a considerable item in the labour account of the photographer; as the public look with but little favour upon an unmounted picture, the number sold is comparatively small. A mounted photograph is seldom so flat and even as the original card, because the albumenised paper, expanded by the moisture of the adhesive material used, contracts in drying, and distorts the card mount; this distortion being generally so considerable, that in the case of a print mounted upon a large card, a decided concavity of the picture results, while a small card nearly covered by the photograph is generally drawn either into a gutter or a

. These disadvantages can be readily over- by adopting the simple and easy expedient of ning the prints, allowing them to dry, and causing them to adhere to slightly damped its by the application of considerable pressure. work of gumming the back of the photographs e very quickly performed if a broad brush is , but as the gumming of paper is now a distinct in London, it is more advantageous to send to be gummed, more especially when the s are printed upon whole. A ream of paper, same size as the ordinary sheets used for graphic purposes (17½ by 21½), can be gummed ndon for about 10s., this sum including the

The gummed pictures are next trimmed in sual way, when all is ready for the work of ting.

card is very lightly damped on the face with a ge, the gummed photograph is placed in ion, and the whole is quickly run through a graphic or a roller-press. Far less moisture is red than might be supposed, as the pressure s to the surface that water which has soaked the card, and the mounted photograph, when from the press, is, to all appearance, as dry it had not been damped at all; and, what is important, it has no tendency to curl. A th lithographic stone forms the best basis upon h to lay the print when the pressure is applied, sheet of smooth card or glaze board should be ver the picture before the leather tympan is d down upon it. Assuming the pictures to be dy gummed, about four hundred per hour can nounted by this method, and it must be mbered that the effect of the pressure is almost valent to rolling. The method to which we refer has long been in use by collotype printers, is country and abroad, for mounting their res, and we know of several instances in which been introduced with advantage in portrait os. A small lithographic or autographic press, ble for work up to about 12 by 10, can be ned for a very moderate sum.—*Photographic*

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ANIMAL INTELLIGENCE.

OPTING the terse language of Shylock, we may ask, Hath a dog reason? And, falling a more lengthy style, we may inquire, Is its ning at all comparable to that of the human ? We think both these questions must be ered in the affirmative. Those who differ us will certainly admit that the possession by of a language of symbols must have an nous influence in increasing the power of his lectual faculties. So much, indeed, must this e case, that what is really only a difference of e is yet so stupendous that an intellect, the uct of the employment for ages of word signs, t be thought to be an altogether new and nal faculty, We are inclined to assert, how- that almost the sole essential difference een the intellect of the dog and that of the man be traced to the above cause. A dog can n, but not by using symbols. It employs the al picture of an object, the olfactory percep- of an agent, the auditory impression of a ding body for the terms of its premises. But sy as these may seem, yet the mind of the al successfully grapples with them. The dog es from the ideas of concrete things, although pable of abstraction and of the formation of a eption. Devoid of generalisations, it deals with culars; but it does reason; it substitutes one for another; it weighs and estimates at their value the successive mental images which nt themselves to itself. Everyone knows the ious memory of the dog, not only for what it een, but for what it has smelt and heard. The tory sense in many species is truly marvellous, its mental grasp or memory of the same is re- able in an equal degree. No division can tifically be drawn between the memory of a scape by a dog and the recollections of a n by a man. Moreover, the dog is not simply chanism, the result of hereditary action. The idual can learn new things—nay, even execute lex mental feats, for itself. The following nce, which forcibly illustrates the power of the ning of the dog, came under our personal notice. ntleman last season bought a middle-aged blue ter, which with his good qualities as a "wide- er" and "staunch pointer" combined the ty of retrieving partridges. When the snipe n commenced in October, the dog took no e whatever of the "longbills," but looked them as vermin and drove them away. After out about six times snipe-shooting, finding his master shot these birds, the dog stood at snipe, and, when killed, dropped it at the sman's feet. The instance is certainly re- able. Such a faculty of ready apprehension reditable performance of a difficult mental (for it must be remembered that he had his litary influences to overcome) would have been d with delight had it been manifested by a who had not the knowledge of spoken language. *neet.*

SCIENTIFIC NEWS.

THE death is announced of Dr. Henry John Hayles Bond, formerly Regius Professor of Physic in Cambridge University. The deceased gentleman was born in 1801, and in 1851 was inducted to the chair of Physic, which he held for 21 years. It was mainly owing to his advocacy that the Natural Sciences Tripos was established, and the study of medicine received rewards and encouragement from the University which it had previously unknown.

Mr. Cromwell Fleetwood Varley, F.R.S., M.I.C.E., &c., the eminent electrician, died at his residence, Cromwell House, Bexley-heath, on Sunday last. Mr. Varley will be remembered as the electrician of the Electric and International Telegraph Company, who were the first to successfully lay a cable across the Atlantic. He also patented many useful inventions, one of these being a musical telephone, which he produced in 1870, and which was played on at the Queen's Theatre, Long Acre, in February, 1877.

Mr. Thomas L. Plant, the well-known meteorologist of King's Heath, Birmingham, died suddenly last week in a carriage on the Midland Railway. Mr. Plant had kept a weather diary for over 40 years, and frequently contributed notes on meteorology to the newspapers and the proceedings of scientific societies. The deceased was in his 64th year.

Tempel's second periodical comet will probably be visible again soon. It was discovered on July 3, 1873, and on its return passed perihelion on August 27, 1878. The period is about twelve months shorter than that of Tempel's first periodical comet, which, discovered on April 3, 1869, returned to perihelion on May 9, 1873, and May 7, 1879.

According to Encke, the period of the comet of 1812 is about 70½ years, and on the 15th inst. it will be seventy-one years since it was in perihelion. There are reasons for believing that its period is somewhat longer than Encke calculated, so that another appearance may be expected at any time within the next few months.

The Saturday evening lecture, during the meeting of the British Association, will be delivered by Sir F. Bramwell, who will discourse on "Talking by Electricity" to the "operative classes," who are popularly supposed to form the audience at the Saturday evening lecture. In large towns such as Glasgow, Birmingham, and Liverpool, a considerable portion of the audience may no doubt be described as of the operative class, but at Southport there are not many of the sort of working men who go to scientific lectures. There is, however, during the fine weather, a regular influx of visitors to Southport on the Saturday, and the authorities are wisely taking measures to provide an "overflow" lecture should it be necessary.

The fate of the Dutch Polar Expedition was known soon after the reward was offered; but no one earned the money, for the news was brought by the *Nordenskjold*, which towed the *Louise* into harbour, and brought the members of the expedition and the crew of the *Varna*, and a despatch from Lieut. Hovgaard of the *Dijmphna*, which was in the Kara Sea, all well. It appears that the *Varna* was severely crushed by ice, and ultimately sank on July 24. The *Louise*, which left Bremen on the 27th of June, on a trading voyage to the Yenisei, lost her propeller.

Mr. Major has informed the Geographical Society that the ancient chart which was discovered in Iceland by Baron Nordenskjold, has arrived at Stockholm. Mr. Major states that in his opinion the relic is not a copy, as supposed, of Zeno's chart of 1558, but is of a later date.

The Brighton electric railway is so far successful that it is proposed to extend it for two miles along the whole front of the Esplanade wall. The car carries twelve persons, but on occasions sixteen, and runs at a mean speed of seven miles an hour, the gradient being 1 in 100. The average daily journey is 25 to 30 miles, and the average number of passengers daily, 350; but on last Bank Holiday the car ran for eleven hours without intermission, except to discharge and take a fresh load of passengers. The motor has a pulley of 5in., and runs at the rate of 700 revolutions per minute. This pulley, by means of a belt, drives a 10in. pulley on a countershaft, and that again drives a 12in. pulley on the axle. The track is about a quarter of a mile long, and in one direction the car runs at the rate of five miles, but returns at the rate of ten miles an hour. Ordinary flange rails with longitudinal sleepers laid on the shingle form the "line," and the rails alone are used as conductors, the loss of current being only 5 per cent. in dry, and 10 per cent. in wet weather. The cost is said to be only a little over one halfpenny per mile per passenger, i.e. the cost of carrying 12 passengers 60 journeys of half a mile is 15s. 8d., which includes 15 per cent. depreciation on £500; but the railway is capable of doubling its traffic without increasing its expenditure, except for gas.

A cabman in Vienna is said to use electric lamps on his cab, and in one announcement we saw it stated that he obtains the current from a dynamo mounted on or driven by the axle!

In fourteen days five accidents with hydraulic lifts are stated to have occurred in the City of London, four of them fatal. Some of these accidents are due to falls down the shaft through unguarded doors.

Some evidence tending to disprove the theory of the prophylactic action of copper has been submitted to the Académie de Médecine by M. Bailly, of Chambly, in the department of Oise. An experience of sixteen years' duration in connection with a factory, where workmen are largely employed in copper, has shown that the employés are not in any degree exempt from typhoid fever, choleraic diarrhœa, and other infectious diseases. M. Bailly's paper has been referred for criticism to the same commission which is already engaged in reporting on M. Burq's hypothesis.

Messrs. J. A. Allen, Elliot Coues, and W. Brewster have called a meeting, to be held in New York on Sept. 26, for the purpose of founding an American Ornithologists' Union.

Mr. Linfield, of Margate, who exhibited his flying machine at the Engineering exhibition last July, has tried it on the West Drayton Railway. The machine was placed on a truck, and drawn at a speed of thirty miles an hour, when, as the news "par." has it, "the machine rose in the air, but the inventor did not ascend with it." We believe he was quite satisfied with the performance.

A meeting of science and art teachers was held in Newcastle-on-Tyne on Monday, 27th August, 1883, and it was decided to form a branch of the Association of Science and Art Teachers. Dr. H. Evers was elected president, and Mr. William John Grey secretary. It is intended to hold a general meeting at Christmas at the Elswick Institute.

USEFUL AND SCIENTIFIC NOTES.

Gilchrist Scholarships.—The Gilchrist Engineering Entrance Scholarship at University College, London, will be open to competition at the end of September. The conditions of examination are this year somewhat altered, in a direction which places the scholarship better within the reach of those for whose benefit it was founded. The detailed regulations can be obtained on application to the secretary of University College. The following is a summary of them:—Candidates must be under nineteen years of age, and must send in notice to compete by the 23rd of September. The subjects of examination are—(1) Elementary mathematics, and (2) any two or more of the following five subjects:—Mechanics, mechanical drawing, essay on one of three given subjects in connection with mechanics or engineering, French or German, the use of tools, either carpenters' tools, or the lathe—wood or metal—or the file. The scholarship is of the value of £35 per annum, and is tenable for two years. There is also at University College a Senior Engineering Scholarship, awarded at the close of the session, of £80 value.

Punching Boiler Plates.—A most effective special tool in the Baldwin Locomotive Works is that for punching the rivet holes in tank sheets. The long sheet is fastened on a travelling trolley, which is moved under the punch by gearing. At each stroke of the punch the sheet moves the proper distance for the next hole, and it goes along automatically till every hole in the row is punched. The sheet is then moved so that another row comes in line with the punch, and the work proceeds of its own accord. As the distance between the holes is regulated by an unvarying train of wheel-teeth, each sheet is an exact counterpart of the other, and the holes come together with exactness ready for riveting.—*American Machinist.*

[illegible]

OBSERVATIONS OF STARS AND PLANETS IN THE DAYTIME.

[illegible] Arcturus [illegible] Ursa Major [illegible] and Vega.

[illegible] Arcturus [illegible] Vega [illegible] Cygnus [illegible] beautifully seen [illegible]

[illegible] like a tiny full [illegible] and very much [illegible] Arcturus seen [illegible] unmistakable.

[illegible] near meridian, [illegible] Jupiter [illegible] very bright and [illegible] very pale [illegible]

[illegible] exceedingly [illegible] well defined [illegible] Hercules [illegible] components exquisitely seen [illegible] near meridian [illegible] Hercules southern declination [illegible] Ophiuchi [illegible] Ophiuchi [illegible] Hercules [illegible]

I find that, with [illegible] instrument, a power of [illegible] is better than any [illegible] for the rapid detection of stars in daylight [illegible] the sight [illegible] darkening of the field produced by increasing the power. It is curious to notice the effect of sunlight *on the lustre of planets*, compared with nocturnal *views of the same*. *Jupiter, near opposition*, is no *mean rival of Venus*, but in daytime [illegible] a very

[illegible]

[illegible]

[illegible] Fig. [illegible]

[illegible]

Fig. 1.

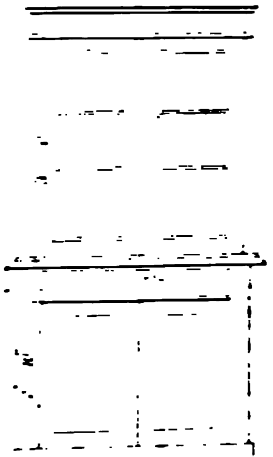
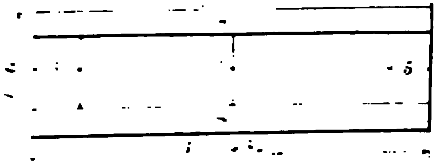


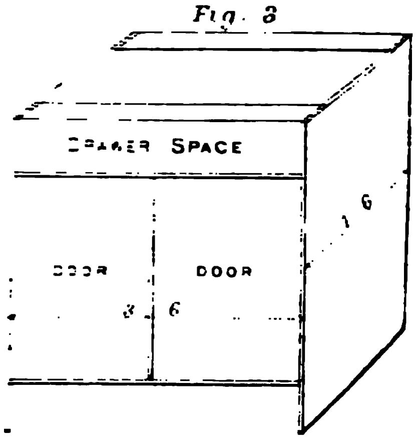
Fig. 2.



[illegible] ends and look for the best sides to turn outwards, then face them over and shoot the front edge straight and square, but be sure and make a pair of them. Now sharpen and set your trying plane fine, and then square the end meant for the top, shooting it with your trying plane, but always apply your square off the front edge and the outside, then breadth them to 1ft. 6in. They are now ready for setting off. To do this, place them in the screw of your bench with the front edge upwards and the insides together, then measure ¾in. from the top end, and with your marking awl draw a line across both edges; then measure 4in. from the first mark and draw another line; then measure ⅞in. and draw another line; then measure 2ft from the the third and draw another; then ⅞in from the last line and draw another line; then take your chisel and transfer the lines to the inside faces, cutting them in as deep as you can. The two lines nearest the top are meant for a frame to carry drawers, and those at the bottom are for the bottom of the cabinet. After you have transferred the lines to the insides, cut a groove between them right across front to back, and about ¼in. deep, then check them ½in. each way along back inside edge to receive the back, and place them on one side. Now take your board of ⅞in. and cut 2 pieces 3ft. 6in. long by 4in. wide, and 2 pieces 3ft. 6in. long by 3in., cut 2 pieces 1ft. 3in. by 5in., and another piece 1ft. 3in. by 3in.: now proceed to make a frame to carry drawer from the pieces like Fig. 2, mortising and tenoning it together. Then cut your bottom 2ft. 4⅞in. long by 1ft. 5⅛in., then cut another piece 2ft. 2in. by 1ft. 6⅛in., [illegible] 2ft. between, leaving 1in. at each end. Take your saw and run a sawcut ⅜in. from the front, then another 1ft. from the first, then another 1in. from the second, then 2in., and another 1ft. and another, and so on across ends, and the same at top and bottom, only leave 1⅛in. at the front. Then take your chisel and cut out all the 1ft. pieces and the first 1in. piece, leaving the 2in. piece in at the front: now take the frame you have made and the bottom, place them in the screw of your bench, front edge upwards; find the centre, measure ⅜in. on each side of centre, mark and draw lines across both edges, transfer the lines to both sides of the bottom and frame, place them flat on the bench, lay division on top with the ⅜in. piece projecting over the front of frame and the pins over the lines you have drawn on the frame and bottom; then with your marking awl draw lines along each side of the pins; then cut holes so that the pins will just fit into the frame and bottom; now dress and square up your other two 3ft. 6in. lengths to 3ft. 5⅛in., and dovetail them into the top of your ends, keeping the 4in. one to the front and allowing it to project ⅜in. over the front. Those that do not know how to dovetail had better get two cuttings, and work away until they learn, as no amount of writing will teach them. Next sharpen your smoothing plane, clean and sandpaper all the insides, and you are ready to put your cabinet together. First take your bottom, glue the pins of the division, place them in the holes made for them, turn upside down, and wedge up firm. Serve the frame in the same way, then turn it on one end, nail on the end along the bottom, serve the other end the same, turn it on its bottom, glue and drive the top rails, then it will have the appearance of Fig. 3; but be sure that it is square and fair, and we will finish it in our next. I forgot to say that the frame would project ⅜in. over the front of the ends.

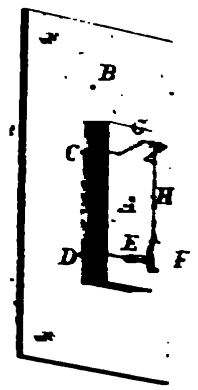
J. P.

Fig. 3



A SIMPLE TELEPHONE TRANSMITTER.

[21770.]—I VENTURE to send a sketch and description of a microphone which I have found to



act successfully as a speech transmitter. It is the outcome of some telephonic experiments I have been making, and I do not recollect having seen one of this description in the "E.M." or elsewhere.

It consists of a matchbox (A), which is fastened on the board B (the copper wires, C D, conveying the electric current will hold it on the board). This acts as a sounding board. Resting on the box, and firmly held there by the wire D, is a small pointed piece of hard compressed carbon (E), such as is used in electric lighting, about ¾in. long and ⅛in. thick. Resting lightly on this is another piece of hard carbon (F) which is round, but having smooth flat sides, about ¾in. in diameter, and ¼in. thick, and is suspended from the loop G by the wire H. The whole may be covered in some way to protect it from the action of the breath, say, by a paper cover.

The finer the point of E, and the lighter F touches it, the more delicate is the microphone.

The battery and receiver are, of course, connected to it in the usual way.

Should any of "ours" feel inclined to try this transmitter, I should be pleased to hear the result of their experiments. **W. R. Hart.**

NOTES ON MAGNETISM.—I.

[21771.]—It is the object of the following notes to give a brief but clear exposition of the leading principles of magnetism considered theoretically. They will be found to embrace as much of the theory as is required for any examination of an elementary nature on the subject. They will also be found serviceable to the general student who wishes to obtain more exact ideas on the nature of magnetism than can be got from the generality of elementary textbooks on this subject.

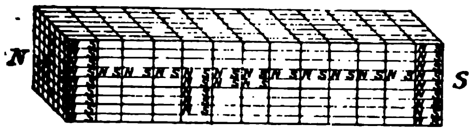


Fig 1

A Simple Magnet.—A simple magnet consists in theory of two points called the *poles*, joined by a straight line of fixed length called the *axis*. The force of magnetism resides exclusively in the poles. The axis is simply a line, having no magnetic properties, which holds the poles at a fixed distance apart. No magnet actually fulfils these conditions exactly. It is a theoretical conception used to simplify the mathematical treatment of the subject. A very long, thin, uniform bar of hard steel (such as a knitting needle), uniformly magnetised is the nearest approach we have to a simple magnet, the poles being situated at the ends of the bar.

Magnetic Polarity.—If A B are the poles of one simple magnet, and *a b* the poles of any other magnet, then it is found by experiment that one of the poles A repels *a* and attracts *b*, while the other pole B repels *b* and attracts *a*. The poles A *a* and B *b* are called *similar* poles, while A *b* and B *a* are called *dissimilar* poles. Whence we have the rule that similar poles repel, and dissimilar poles attract.

North and South Poles.—When a magnet is freely suspended, it is found that it always turns so as to make a certain angle with the meridian of the place. This position is the same for all magnets at the same place and time; but varies for different places and for different times. In England one pole always turns to within 30° of due north. This pole is accordingly called the North pole, the other pole being the South pole.

Law of Attraction and Repulsion.—It is found by experiment that the force with which the pole of one magnet attracts or repels the pole of another magnet, is different in different pairs of magnets. The force with which the pole A attracts or repels the pole *a* of a standard magnet at a given distance is called the strength of the pole A. It is found that the force with which two dissimilar poles attract, or similar poles repel each other, is directly proportional to the product of their strengths, and inversely proportional to the square of the distance between the poles. The magnets are here supposed to be sufficiently long to put the other pole of each out of the action of the poles experimented on. It is also found by experiment that the force of attraction or repulsion between two poles is influenced by no other circumstance. We may thus conceive the force of magnetism to be radiating uniformly in all directions from a magnetic pole.

Poles inseparable.—The poles of the same magnet are equal in strength. They are also *inseparable*, i.e., it is impossible to obtain a north pole, without, at the same time, a south pole of equal strength.

Magnetic moment.—The product of the strength of either pole of a magnet, and the length of the axis (or distance between the poles) is called the magnetic moment of the magnet.

Constitution of a Magnet.—Suppose a number of precisely similar and equal simple magnets to be joined together in a straight line, so that the north pole of any one coincides with the south of the next, thus:

N——SN——SN——SN——S

Then all the intermediate poles neutralise each other; only the end poles being effective. This combination is equivalent to a simple magnet, in length equal to the united length of the component magnets.

Suppose a number of simple magnets to be placed side by side with all the north ends pointing one way, thus:

N——————S
N——————S
N——————S
N——————S

Such a combination is not reducible to a simple magnet with only two poles. We have a number of north poles in a straight line, and a number of south poles in a straight line. If there are an indefinitely large number of precisely equal and similar simple magnets arranged in this manner, we get a line of north magnetism and a parallel line of south magnetism at a certain distance from each other, and these lines of magnetism take the place of the pole of a simple magnet.

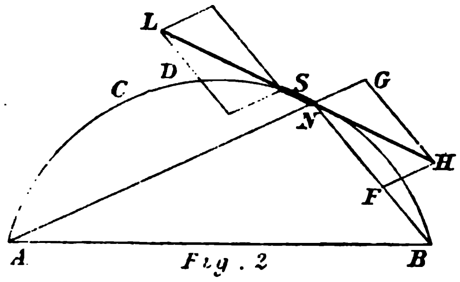


Fig. 2

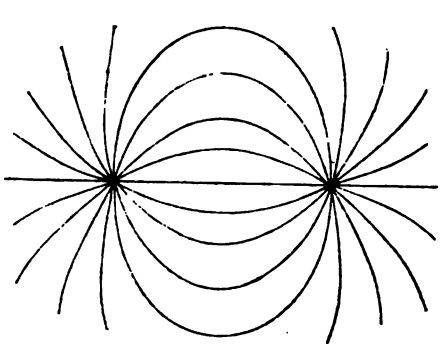


Fig. 3

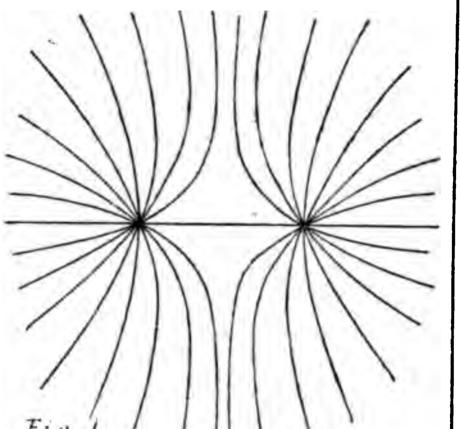


Fig 4

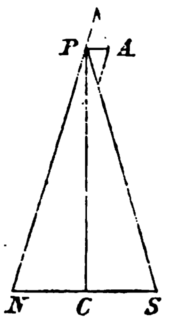


Fig. 5

Suppose now an indefinitely large number of precisely equal and similar simple magnets to be placed side by side so as to form a parallelopiped. We have now at one end a north magnetic surface, and at the other a south magnetic surface, and these surfaces take the place of the poles of the simple magnet.

We can now investigate the constitution of an ordinary bar magnet. Imagine an indefinitely large number of small simple magnets packed together so as to form a parallelopiped in the manner shown in Fig. 1. If all the component simple magnets are equal and of equal strength, all the poles in the body of the magnet destroy each other's action. There only remains the free magnetism of the north and south ends. Such is the constitution of a *uniformly magnetised* bar—i.e., one which may be regarded as composed of equal simple magnets of equal strength throughout. But if the component simple magnets are not of equal strength, then the bar is not uniformly magnetised. In this case the adjacent poles are not exactly neutralised, and we have north magnetism irregularly distributed over one half of the bar, and south magnetism over the other half of the bar. In all these cases there is no single magnetic pole; but, as will be shown hereafter, such a magnet has a definite magnetic moment. It is obvious that if a bar be very long in proportion to its thickness, and uniformly magnetised, it may be regarded as a simple magnet with the poles at the ends.

Any bar magnet may, by actual division, be broken up into elementary magnets in the above manner. It is seldom, however, that a magnet in practice is uniformly magnetised, the magnetism of the elements becoming stronger towards the middle. Such a magnet, as above explained, instead of having a single pair of poles, has an infinite number of north poles along one half of its length, and an infinite number of south poles along the other half of its length. It is, however, approximately equivalent to a simple magnet having its poles slightly within the ends of the bar.

Intensity of Magnetisation.—We have seen that any given magnet has a definite magnetic moment. The magnetic moment is proportional to the bulk of the magnet if the magnetisation is uniform. The magnetic moment of the unit of bulk is termed the *intensity of magnetisation*. Hence the intensity of magnetisation of any magnet is found by dividing its magnetic moment by its bulk.

Lines of Magnetic Force.—Let A B be the poles of a magnet (Fig. 2), and C a small magnetic needle. Then, if C is moved from A to B, along a line such that the motion of the needle is always in the direction of its own length, the path which it pursues is called a *line of magnetic force*.

The position which the small needle will assume at any point may be found in the following manner:—Let A and B be the north and south poles of the magnet, and N and S those of the magnetic needle. Then A repels N in the direction A N, and B attracts N in the direction N B. The magnitudes of these two faces are inversely as the squares of A N and N B. Consequently, if we take N G in A N produced, and N F in N B. such that

$$NG : NF : : NB^2 : NA^2,$$

and complete the parallelogram G N F H, the diagonal N H will represent the direction of the resultant force acting on N.

In the same manner, A attracts and B repels S, and the resultant force, S L, may be found in precisely the same manner. If N S be very short compared with A B, L S and N H are parallel, and N S will take up such a position that L S, S N, and N H may be in the same straight line.

If now we draw a curve, A D B, such that at any point in it the position of N S, found as above, is a tangent thereto, the curve A D B is a line of magnetic force. Some of these lines are drawn in Fig. 3. It must be observed that every line proceeding from one pole ultimately comes round to the other pole.

If two long magnets, A B and C D, are placed parallel to each other, so that similar poles, A and C, are opposite each other, while the poles B and D are far enough off not to exert any perceptible force on a small needle placed near B and C, a series of lines of magnetic force are produced of a different kind. The position of the magnetic needle at any given point may be found as before, Fig. 4 represents the lines of magnetic force in this case. They are all of infinite length, receding continually from each pole.

Magnetic Field.—Any portion of space traversed by lines of magnetic force is called a *magnetic field*. If the same lines of magnetic force traverse two portions of space A and B, then the strength of the magnetic field at A is to the strength at B as the number of lines of magnetic force that pass through a small area perpendicular to their direction at A, is to the number of lines that pass through the same area at B. Hence the magnetic force increases as the lines of magnetic force get closer together. It consequently follows that when the lines of magnetic force are parallel, the strength of the magnetic field is uniform.

Couples.—In the preceding investigation the forces acting on the poles of a small magnetic needle are assumed to be equal, opposite, and parallel. Such a combination of forces constitutes a *couple*. The theory of couples belongs to mechanics. We here give some of their chief properties.

1. The magnitude of a couple is measured by the product of either force into the distance between them. This product is termed the *moment of the couple*.

2. When a couple acts on a rigid body it tends to produce rotation, but not to produce any motion of translation.

3. Two couples in the same or parallel planes are in equilibrium when their moments are equal, if they tend to produce rotations in opposite directions.

4. Any number of concurrent couples in the same or parallel planes is equivalent to any single couple in the same, or a parallel plane, whose moment is equal to the sum of their moments.

When a simple magnet is placed in a uniform magnetic field, it is acted on by a couple proportional to the magnetic moment of the magnet, and to the strength (or intensity) of the magnetic field. The magnitude of this couple will vary with the angle the magnet makes with the lines of magnetic force, being greatest when the lines of magnetic force are at right angles to the magnet, and vanishing when the magnet is parallel to them. Conversely, the moment of a magnet is proportional to the moment of the couple which acts on it in a magnetic field of known intensity; hence, it follows (from the principle No. 4 above) that the magnetic moment of any number of parallel magnets rigidly connected together is equal to the sum of the moments of the component magnets. The necessity for the component magnets being parallel is obvious, for otherwise the angles they make with the lines of magnetic force would not be the same. Hence, the magnetic moment of any bar magnet is equal to the sum of the moments of all the elementary magnets of which it is composed. The magnetic moment of any bar magnet is therefore a definite quantity which may always be experimentally determined, however the magnetism may be distributed in the magnet.

To Compare Two Magnetic Fields.—If a magnetic needle be disturbed from its position of rest it will vibrate; and if the lines of magnetic force are sensibly parallel, it can be shown that the number of vibrations per minute are, for any given needle, proportional to the square root of intensity of the magnetic field. Hence, if a needle vibrates n times a minute in the field A, and p times a minute in the field B, then the intensity of the field A is to the intensity of the field B as n^2 is to p^2.

To Compare the Magnetic Moments of two Magnets (Fig. 5).—Let N S be the poles of a magnet, and let N C = C S. Let P be the north pole of a small magnetic needle, placed so that P C is at right angles to N S. Then N repels P in the direction N P, and S attacks P in the direction P S. If a be the strength of one of the poles of the magnet N S, and b be that of the pole P, then the magnitudes of each of the preceding forces will be $ab / (NP)^2$. The resultant P A of these two forces is parallel to N S, and equal to $[NS / NP] \, . \, [ab / (NP)^2]$. Let m be the magnetic moment of the magnet N S, then the force which N S exerts on P is $mb / (NP)^3$. In this expression, the strength of the magnetic field produced by N S at the point P, is represented by $m / (NP)^3$; and this is equal to $m / (NC)^3$ nearly, if N C is great compared with N S. Thus, keeping N C constant, the magnetic moments of two magnets may be compared by finding the comparative intensity of the magnetic field produced by them at P.

In order to do this practically, the effect of the earth's magnetism must be eliminated. This may be done by placing N S parallel to the lines of the earth's magnetic force. If N S be placed in the direction of an ordinary magnetic needle, but with the N pole towards the south, the lines of magnetic force produced by N S at P will be concurrent with those due to the earth. Hence, we may compare the strength of two magnets as follows. The number of vibrations of a small magnetic needle under the influence of the earth's magnetism alone is first observed. Let this be n. The number of vibrations (p) is next observed, when the magnet A is placed as above described, and the needle is at P. Finally, the number of vibrations (q) is observed, when the magnet B is placed in the same position. Then we have the proportion—

$$p^2 - n^2 : q^2 - n^2 :: \text{moment of A} : \text{moment of B}.$$

Gavin J. Burns, B.Sc.

KEY CHARACTERISTICS IN PIANO MUSIC.

[21772.]—When one is in the wrong, I believe the proper course to be pursued is to take the earliest opportunity to acknowledge it, which I hereby do with regard to my statement that the white and black claviers are unequal levers as they appear in the piano, and of course, designating the difference between them as "palpable" was founded in error. For I find, on careful inspection, that the fulcrums of the black claviers are set farther back than those of the white, and on measurement and calculation, both levers seem equal to a fraction. I therefore beg to offer my fullest apology to Mr. Child for anything I may have said hurtful to him while under such erroneous belief.

But while admitting having been wrong in the particulars stated, I am still under the impression that it is to the mechanical inequality of these levers, as fingered in certain cases, that Mr. Stoney attributes the characteristics, and my first reply to Mr. Oliver was probably pretty near the truth as far as it went. What I wish to convey now is that though the levers are equal when each is pressed at its extreme end, in fingering in some of the keys, the fingers will be so grouped that the white claviers will be pressed down at a considerable distance from the end, and as the fulcrums of the white are so much nearer than those of the black, it is the white claviers that thus become less powerful and quicker in action. Of course, I do not attempt to give the reason why this quicker action on the strings should produce any different quality in the tone produced—that I should expect to be treated in the paper on the subject, if my hypothesis of Mr. Stoney's theory be correct. Being now about to start on a trip that may occupy some weeks, I wish to make *l'amende honorable* before seeing the next "E.M.," which is to appear to-morrow, and I hope on my return (if some other correspondent does not do so in the mean time) to refer to Mr. Stoney's paper, if possible, and give more definite particulars of his views, whatever they may be.

August 30. **Captain Cuttle.**

[21773.]—The discussion on this subject has much interested me, and I am tempted to say a few words, as it seems to me that your contributor, "Capt. Cuttle," has gone wrong in his views as to the cause of the difference in effect of the various keys; for this reason, that the mechanical effect of a lever does not in any way depend on the absolute length of it, but on the position of the fulcrum relatively to the two ends. If therefore, two levers of unequal lengths have their fulcra so placed that their two ends bear the same ratio to each other, their mechanical effect is exactly the same.

In the organ this question of mechanical effect is entirely eliminated, as each pipe sounds by the opening of its particular pallet, and it cannot in the least matter by what means it is opened. Yet the different effect of the various keys is exactly the same on this instrument (when equally tempered) as it is on the pianoforte. This fact alone (which cannot be disputed) seems to me to demolish "Captain Cuttle's" position utterly, and, apart from this, if he will open his piano, take out two keys and carefully inspect and measure them, he will find two things: (1) That both keys are weighted on their inner ends to precisely the same amount, and (2) that in the black key, the length from the sticker at the back to the pinhole bears exactly the same proportion to the length from the pinhole to the front end, as in the white key; that is, that, regarded as levers, they are similar in every respect and precisely the same in mechanical effect. For my part, I can see no more reason to doubt that the differences existing under the equal temperament are due to that system, than there was to doubt that the very startling effects produced under the unequal temperament were due to *that* system and to nothing else. **H.**

FREE REEDS.

[21774.]—The letter which appeared on p. 603, by Mr. N. E. Child, does not eventually contradict the statements put forth by me on p. 580, which I will endeavour to prove. Mr. Child says (p. 603) that "I see one of your correspondents imagines (for it is obvious he does not speak from experience) that the shape and position of the tubes necessitates voicing." I am fully aware that this remark is intended for me; but Mr. Child's assertion that "he does not speak from experience" is false, as I am prepared to say that I have actually tried the experiment, and I am quite convinced that the tubes, if made to a certain size and form (according to the tone required), do greatly influence the character of tone emitted from the reeds, whether they are voiced or not; but, I may add, that under the conditions with which I have tried the experiments, voicing the reeds is not in the least required, or in any way necessary, simply because the shape and size of the tubes, and also their position on the soundboard, had all the desired effects in the various sets of reeds, of producing characteristic tone. I have nothing to say against voicing the reeds, only that it is an art in which very few excel, as it evidently requires great skill, practice, and judgment, in order to produce any really good results. As Mr. Child, p. 603, fails to understand exactly what I mean on p. 580, I will put it somewhat plainer for him. I maintain that when all the tubes are made to one scale, it does not influence the tone. What has to be done, then, in order to produce characteristic tone in the various sets of reeds? All that can be done in this case (which is a general one, but not without a few exceptions) is to voice the reeds according to the tone required. This "all" is something almost, if not altogether, beyond the usual skill of any amateur. I have proved its difficulty of accomplishment in many instances myself. Even with thorough practical reed organ manufacturers, the difficulty of voicing reeds to produce true characteristic tone is exp enced. This, no one will deny; in fact, i already universally proved by the fact that th are hundreds of reed organs made and sold that not possess true characteristic tone in the vari stops. Of course, I do not refer to mechan stops, such as the vox humana, tremolo, or fo stops. Voicing the reeds does not affect the r chanical stops in any organ. I must inform Child that I have read the letters referred to; bu do not find in them anything contradictory to statements made by me on p. 580 of the last volu I must also inform Mr. Child that my statem do not refer to harmoniums at all, but to inst ments constructed on the suction principle, such those known as American organs. The refere made to Mason and Hamlin's orchestral organ Mr. Child does not prove me in the wrong at simply because that organ is constructed on a ferent principle to the ordinary American org which contains the exhaust bellows, the orches organ being furnished with a pressure bellows in the harmonium. My statements with regar the influence of the tubes on the tone applies to organs constructed on the suction principle. have nothing to say regarding the influence of channels on the tone, in harmoniums or org with a pressure bellows, as I have not tried experiments with such instruments; but I alw like to see any correspondent state his opinion these matters, if from practical experience. If f any other conditions, or from a mere theoret point of view, I allow it to pass aside as s unless I can find some good grounds to contra any such statements. In conclusion, I should to refer our readers to the remarks made "Organon" on reed voicing (p. 581), the diffic of which is nicely explained when that gentle says that "the operator will have some little di culty in getting the original tone back again." have previously been writing for the benefit those who, like myself, have experienced the d culty of voicing the reeds to produce true char teristic tone. I can voice reeds to a certain ext but I can rarely or ever do it to my own satisf tion. Men of far greater experience than which I have had, have given it up in despair; however, I intend to persevere in the art as o as I can get the chance, although I know of ot means to obtain characteristic tone; but, I admit, not quite so perfect as that obtained really good and skilful voicing. **G. Frye**

THE FLUTE.

[21775.]—Messrs. Rudall, Carte, and publish a book on the construction of the fl by Theobald Boehm, the inventor of the cylin flute, with parabolic head joint, and I wo recommend all those of "ours" who would lik make their own flutes, clarionets, &c., to obtain

At the same time I, like "E. P." (letter 217 would be glad to see a good article or two on th subjects in these columns; for, judging from queries which appear from time to time, th seem to be a goodly number of "our interested. **Old Blow Hard**

CLARK'S IMPROVED DIAMOND HIVE.

[21776.]—I am glad to find that my letters s likely to induce others to give descriptions of v ous systems of constructing movable frame hives. The first who has done so has given which is entirely new to me, and which seems t known as the "Diamond Hive." Mr. Clark m tions three serious objections to this hive, as usu constructed, and which, he says, his improvem have overcome. The one fault which he finds the ordinary bar-frame hive being the drau round the ¼in. passages at ends of frames, which, he says, does not exist in his hive.

Mr. Clark says, "The accompanying draw will explain themselves." Now, I have had a g deal of experience in making working drawi and in working from drawings, yet I must say I do not quite understand these. At first sigh the drawing of frame I thought that I underst it at once, my idea being that the projectio corner of frame marked 2¼ by 1½ was equivalen wide shoulder of ordinary bar-frames, and that small piece at right angles to it marked ⅜in. intended to keep the frame out from the side hive, and give the bees a passage round the fram but though I cannot make anything else out of drawings, I think I must be wrong, as this wo leave a ⅜in. passage and consequent draught, entirely do away with the benefit proposed to derived from this system of construction. Ag in the description, Mr. Clark says: "The fra are supported by two arms, 11½in. long by 1 wide at upper shoulder, kept off from the hive s by ¼in. slips inside same." This seems to pro a passage of ¼in. between the frames and the s of hive; but as the absence of such a pass seems to be the essential feature of this system hive construction, I suppose I must be wron this also, though I cannot make anything else out of the description. I am also inclined to think that I must be unable to understand the matter rightly, because, according to the only meaning I can make out of the drawings and description, the measurements as given in each do not correspond with those given in the other. There are also some other things in the drawings which I cannot understand. There is a board projecting from the front, and I am entirely at a loss to know whether it is the roof of a porch, or a movable hinged-shutter to close a pane of glass, which may be indicated by a quadrilateral figure in the front of hive just above it; then what is the other quadrilateral above that again? and the other near the bottom of the front, and the small object below that? And how are the entrance, flight board, and porch (if there is any) managed?—all of which are items of some importance.

I understand the way the double tiers of sections are put on the hives, and am sure that the bees will take to them very readily—more so than, in some instances, they will to sections in crates placed over the frames in ordinary hives, but not more so than to those placed in frames close behind the brood nest in the improved combination hives. There are other things which require to be explained in this hive; there is a line and some dots in the upper corner of frame—what are they? how is foundation put into those frames? There are also a few other questions which it would be instructive to have answered: Were the hives mentioned, which were only one eighth of an inch thick, in which the colonies of bees wintered so well, diamond hives of the old construction, or were they "Clark's Improved Diamond Hives"? were they bar-frame hives in which the bees succumbed, and those in which they were a fortnight late in swarming, double or single, and were any of them only an eighth of an inch thick? how many of each kind were there in the apiary in which they were under equal conditions as regards situation, food, &c.? (which I suppose includes original strength of stock). Also how long has Mr. Clark been using his improved diamond hives? how many stocks has he had in them each winter? and what were the results obtained from them in honey production each season, and this season in particular?

I hope very much that Mr. Clark will give a farther explanation of his hive, with a cross section showing frame and sections in position, and giving height and thickness of sides, &c., and that he will kindly answer the questions which I have asked. I really ask for information, as I am quite sure it would be a great matter to get rid of the draughts caused by the passage round the ends of the frames, if it could be done without counterbalancing disadvantages; and I would be glad if the subject were discussed in the "E.M." by those who have had practical experience of wintering bees in differently-constructed bar-frame hives.

I would most strongly recommend anyone who has bees, or intends to have them, to get and read up the "British Beekeeper's Guide," by Cowan, published by Houlston and Sons, Paternoster-square, price 1s. 6d.; and also "Wintering Bees," by same author, price 3d.; published by the British Beekeepers' Association. No one should attempt to go in for bees without having those two books and reading them, and really marking them up carefully. "Modern Beekeeping," recommended some time ago in the "E.M.," was a very good book in its day; but, though said to be a new edition, "revised and enlarged," and having the date 1882 on its title page, it is very much behind date, and the B.B.K. Association, by whom it is published, should have it rewritten at once, as in its present state it is in some respects calculated to mislead.

I hope we will get the benefit of the experience of practical bee-keepers; but I also hope that descriptions of hives will only be given by those who have either made or used them, and that the class of contributors who are so fond of giving their ideas and suggestions on any blessed subject which turns up in the "E. M.," which they understand, or think they understand, will "keep their fingers out of this pie."

Finally, as to wintering bees in combination hives furnished with Association standard bar frames, like everything else, there are, at least, two ways of doing it; but I think that anyone who will read Mr. Cowan's little tract mentioned above, will be convinced that, if done the right way, it can be done safely, well, and reasonably easy.

G. J. H.

ALUMINIUM PLATE REACTIONS.

[21777.]—The correspondence on the above subject, published on page 604, letter 21761, calls, I think, for a few words of comment from myself.

In the first place, let me say that the substance experimented on was *not* chloride, but sulphate of zinc; not a bad sample either, being much more free from Cl in fact, than the portion so kindly sent me by Col. Ross, for while mine gave no indication of Cl with the silver nitrate test, the other sample showed its presence very perceptibly under like conditions.

I think it necessary to say this much, in order to prove that in my case Cl had nothing to do with the failure of the plate. This failure, from subsequent trials, I am now satisfied was entirely due to the plate itself, but whether through impurity, or insufficiency of substance, I am not prepared to say. I hope shortly, however, to obtain a piece of plate of the *exact* dimensions specified by Col. Ross, from the dealers he recommends, Messrs. Johnson and Matthey, and will then be glad to report results. In connection with this, I would suggest that if Col. Ross would give the *thickness* in parts of an inch (length and breadth being already so given), he would confer a favour on those of his students who have to obtain their supplies by post.

With respect to the statement that "the chloride is the only salt of zinc which melts in its water of crystallisation," I think Col. Ross is in error. When we consider the formula of zinc sulphate $(ZnSO_4 + 7H_2O)$, it is scarcely to be wondered that it should, as I stated, "fuse in its water of crystallisation." But this "aqueous fusion" must not be confounded with "igneous fusion," which is a very different thing.

Barnsley. **J. Tomlinson.**

P.S.—Permit me to tender my warmest thanks to Col. Ross for the kindly manner in which he replied to my letters, and for the trouble he has put himself to in the matter.

TRANSFER OF THOUGHT.

[21778.]—I agree with your correspondent, "F. W. H.," that the phenomena of Spiritualism, &c., &c., are now being attacked at the root by men like Haeckel and Buchner; but I daresay the majority of the persons who delight in spiritualistic performances are scarcely "advanced" enough to follow the great German scientists. They prefer to amuse themselves by trying all sorts of childish experiments in dark rooms, and fondly believe that they are "investigating the phenomena." At the same time, some cases of thought transfer may be possible from a physical point of view; and I would like to refer "F. W. H." to my letter No. 21624, page 457, in which a theory is suggested. A connection *might* be established between two brains by means of the luminiferous ether. I do not think this is at all probable—in fact, it is most unlikely; but still it is possible. At the same time, thought transfer is not by any means a scientific fact so far, and I am very much disposed to be sceptical about it. **Wm. John Grey.**

Elswick Science School.

[21779.]—I do not quite see what bearing the matters mentioned by "F. W. H.," 21747, p. 602, have on this subject. True, the foundation of all spiritualism is attacked by various students of natural science. What of that? The attack is not a destruction, nor can it ever affect in any way the foundations of spiritualism. Of course, by spiritualism I do not mean the alleged phenomena of mediums and so-called spiritualists, but the belief in the spiritual nature of man, or in anything apart from matter. No amount of materialistic attack or evidence will ever affect this belief or disprove it, though it may destroy the faith of individuals. The belief itself is founded upon faith and inward convictions, and, therefore, is unassailable.

The spiritual idea is, in fact, wholly independent of the material, though coincident with it. Thus such circumstances as the loss of intelligence as the body wears out in no degree whatever *disprove* the existence of the distinct spiritual essence. If a workman is deprived of his tools, his power of work is lowered; if the scientific experimenter is shut out of his laboratory, he cannot work; to come even nearer, if a cataract forms on the eye, the man loses sight though his brain and optic nerve remain perfect. If the spiritual essence exists, it is still certain that in this state of existence it is absolutely linked to, and operates only through, the agency of organised matter. Therefore, no mere study of the actions of organised matter, no effect of the failure of the organs, at all touches the question of the existence of the agent of which these are admittedly the essential tools.

In other words, the fact that the supposed spiritual agent can operate, in a material world, only through matter, does not touch the question of the existence of such an agent, independent of matter, in another form of being. That subject belongs to a wholly different order of evidence and argument, which, of course, is not suitable to these pages. Nor has science anything to do with the matter, any right to meddle with it, or any power to pronounce upon it. **Sigma.**

THE PANAMA CANAL AND THE GULF STREAM.

[21780.]—In letter 21752, your correspondent anticipates a terrible fate for Western Europe. This, I am aware, is not a new idea, and the objection was raised some time ago by the opponents of the Panama Canal scheme. Yet, in spite of that, the canal is to be made, and the nations of Western Europe are calmly looking on at the sealing of their death-warrant. Now I seek for information. What is the course selected for the canal? What will be its dimensions, and through what geological formation will it pass? But, above all, how long will it probably take the Gulf Stream to bore a way for itself sufficiently wide to appreciably affect the climate of our country? We know what immense periods of time have been occupied in making even small differences in our own coasts, even where the cliffs are of soft materials; and I think we may ease our minds of any fear of our nation's destruction. Other and much greater changes are likely to take place quite as soon; and if we are to be alarmed now by the fear of what may happen ages hence, we had better liquidate our national affairs and emigrate *en masse*. But, joking apart, I should like to have the particulars of an undertaking so important commercially, at least.

Salvo Jure.

[21781.]—None of the direful consequences foretold by Patrick Gannon (21752, p. 602) are possible. I guess he has never seen the Gulf Stream, and I have several times. If he and other timid folk will just consider that this stream is a body of water so great as to affect the climate of vast regions, and of such power as to find its way from the tropics to Norway, they may see that the effect upon it of the Panama ditch will be comparable to the waste of water from a ½in. pipe upon the reservoirs supplying London.

If any eroding effect were produced—nay, if any current at all were to be set up by the expected action, the entrance to the canal would have to be guarded by gates, or else the traffic would only be possible in one direction, and that have to be effected in great danger.

The Gulf Stream is only very slightly due to the rotation of the earth, because the water itself is impressed with the motion just as much as the solid earth; it results mainly from tidal action and the easterly trade winds. **Sigma.**

THE SYMBOLIC REPRESENTATION OF FEET AND INCHES—A SUGGESTION.

[21782.]—It being undesirable that the symbols used to designate minutes and seconds of *arc*, should become in general use to represent *feet* and *inches*, I venture to place before the readers of "ours" who prefer calling "a spade, a spade," instead of by any other name, a suggestion which I think will meet with their approval;—that is the approval of those who prefer using symbols instead of the abbreviations *ft.* for *feet*, and *in.* for *inches*; though no doubt many, like myself, prefer the abbreviations in place of symbols. I may here say that the use of the symbols ′ and ″ for feet and inches always puts me in mind of those members of the Asiatic Society, who persist in styling themselves "F.R.A.S." instead of "M.R.A.S.," thus leading one to imagine they are Fellows of the Astronomical, whereas they are members of the former Society

If symbols are to be used for linear measure—and from the frequency with which one comes across them it would appear that they are to be made use of—then by all means let them have a distinctive character from those which by right and long usage are commonly recognised as representing a different kind of measure, and thus put an end to the confusion to which one is liable when reading an article in which the same symbols are employed to designate both *linear* and *arc* measurements.

The English foot being based upon the length of the human foot—hence its name—I would suggest that the character π, which is the first letter of Greek word *pous* (the *foot*), and δ, the first character of the word *dodekatos* (the *twelfth*), should be substituted for ′ and ″ to represent feet and inches respectively. Thus for 10ft. 6in., and 6ft. 10in., we should read—

$$10\pi.\ 6\delta.\ \text{and}\ 6\pi\ 10\delta.$$

respectively, instead of 10′ 6″, &c., which is the absurd fashion now prevailing.

Dalston, E., Sept. 3. **B. J. Hopkins.**

THE PARKER-SMITH BRAKE.

[21783.]—Your correspondents, "Imprimatur," "H. S. J.," and Mr. Parker-Smith, page 603 of last volume, appear to be of opinion that the *only* reason why this brake does not fulfil the necessary "conditions" is "that mineral trucks are run between the engine and the passenger coaches." This, however, is not the only cause.

The Board of Trade Return, and also your correspondents' letters, show that this brake is fitted to but *three carriages* and not to any engines: it, therefore, follows that even if the "mineral trucks" were to be removed from the train, the brake would not then fulfil the "conditions." As it is not fitted to the engine, it could not be self-acting upon the engine in case of accident, nor could the engine brake be under the control of the guard

Mr. Parker-Smith states "that he can obtain simultaneous action throughout a train, whether it be long or short." At present the correctness of this assertion cannot be proved, as only three carriages are fitted. I trust that at no distant date sufficient vehicles will be in use to practically test the question. I have seen experiments made with various forms of "chain" and "mechanical" brakes, in which the brake force is not transmitted through the continuous connections, yet in not one single case have I found "simultaneous action," or even any near approach to it. The advocates of the Heberlein brake state that theirs is the most perfect of the "mechanical" systems, yet we know from practical experiments on English railways that it cannot act simultaneously. I know from experience that mechanical brakes do not work well on trains of ordinary length, and I fail to see any reason why the Parker-Smith brake should be an exception to the rule.

In conclusion, I must remark that nothing in the letters of your correspondents alters the plain *fact* that in the Board of Trade Returns the Parker-Smith brake is stated *not to* fulfil the necessary "conditions." At some future time it is possible that improvements may be made in the details. This is not, however, the subject now before us. To estimate the value of any appliance, we can simply deal with the question as it is at the present time. It should also be remembered that, although many engineers have inspected this brake, *no other* companies adopt it. **Clement E. Stretton.**

Brighton, September 1st.

LATHE MATTERS—PHOTOGRAPHY—OPTICS—VARIOUS.

[21784.]—There seems a strange apathy on the part of our most valued contributors, with the exception of one or two; I have nothing of value myself to send, but I write in the hope of moving somebody, though it be but to kick me.

First, then, when "J. K. P." says that in tapping cast iron it is better to leave the rounded part out of the question, does he mean this literally—that the holes should be bored *at least* ¼th depth of thread larger than the theoretical size? Also, taking average workmanship, what difference would he allow for other materials—for Whitworth threads? Can he tell me if gas thread should be rounded and of same angle as Whitworth, or not? Also, is it good practice, or rather the reverse, to let the tap act somewhat as a reamer?

A friend of mine just back from Germany declares he saw at Heidelberg, among the antiquities dug up in the castle, and now in the museum, a large screw tap of rough make, perhaps 8in. or more long and 3in. diameter, with threads of 5 to the inch, or thereabouts. Is this likely to be a genuine antique?

Daguerre's monument seems to have produced a capital crop of scientific "croppers." Let me add to those on page 599 the statement in another daily, "Herschel's discovery of the use of hyposulphite of soda in *developing* the image, &c." Please, somebody, give all the instances of use of hypo as a developer?

Will "O. V." kindly say if the subject of spherical chromatism is anywhere mathematically treated, or if he is the first to bring the matter to the notice of theorists? I can't help fancying that mathematicians tacitly assumed (or accepted) that altering the character of curves would seriously affect the balance of spherical aberration, and would produce but small effect on colour, whereas it would seem that having destroyed sp. ab. by proper ratios of *radii* we may sometimes play considerable tricks with the nature of the curve. Practical men do not as a rule seem to have known where theory was wrong (eh, "Prismatique"); but to have found out by rule of thumb a way of correcting the error. I suppose I ought to except Gundlach, though. In old days lenses were supposed to be ground to spherical curves, and if the curve were altered, it was not intentionally so, but in the ordinary course of manufacture. In an old book I once read that out of the same two kinds of glass a number of lenses were ground *exactly* (?) alike, and to such spherical curves as theory dictated (so that any one crown, and any one flint, taken at random, should have given a good glass), but that, in practice, a flint was tried with each of the crowns in turn, till a suitable match was found. The writer gave no reason, but apparently assumed that the difficulty of getting correct radii made the large stock and process of trial necessary. One can hardly suppose that the great makers of large glasses worked in this way, and smaller men made but small glasses or bad ones. This extract is but of small value; but as bearing on the question of retouching, I send it for what it is worth. The work was an expensive one in its day, a day so long ago that chlorine water was a new discovery and called oxymuriatic acid.

Will anyone tell me how large circles, as transits and mural circles, are divided? The tangent screw method seems inapplicable, and if the circles be on the cylindrical surface, and not on the flat face, *beam compasses seem inapplicable* also. I can only *suppose* that an accurate tangent wheel is attached to the circle concentrically and moved by a train of wheels, as in "J. K. P.'s" dividing engine.

Did "D. H. G." ever see an article by Mr. [illegible] *Rose*, claiming to write Q.E.D. to the proposition "that it is necessary to assign definite angles to lathe tools?" The article was in a back vol. XVI.–XXV.; but I have never seen any reference to it, so assume our friend either disdained to reply, did not notice it, or, worse still, accepted the reasoning as conclusive. Among many others which my modesty has made me keep back, I have a letter in my desk, months old, which I shall have to sling at the mechanical giant if better champions won't come to the fore.

About that screw question, too, why do not some more of our practical readers take it up? Holtzapffel's screws are perfect for this purpose, and are so widely in use that they are a standard. That they will not "live" is certain: but certain people are anxious to kill them as soon as possible.

Why won't "J. K. P." give us a few articles on the subject, telling us what threads are in use, what ones may be dispensed with, and how we may best aim at simplification? Surely, angles of 45°, 50, 55, 60, and 90, are not all necessary.

Dr. Edmunds says in a back letter that his thread is *rooted* (or some such word) more strongly on its shaft than Whitworth's. There is a sense in which this is true, but I don't think he means it: and I should be glad to know what he means. By the bye, Dr. Edmunds is very fond of the question, "In what respect are H. and Co.'s threads better than mine"? Did it never occur to him that for him to ask the question is somewhat what boys call "cheek"? When a man comes and asks us to destroy goods of a well-known pattern, proved to be good, to throw aside valuable property, and substitute more of a new design of his own, and at considerable cost, it is for *us* to ask *cui bono*; and if Dr. Edmunds is asked in what respect his own thread is superior to H. and Co.'s for die-cut screws, of short length, used as "cement," he would have no very good answer. He must not think I am against action; I am only anxious that any change should tend towards a simplification of screw standards, and that the decision should not be hastily arrived at and require revision later on. Any new thread should displace not one, but, if possible, several old varieties.

A little time back there was an article (American?) on the proper longitudinal section for lathe mandrels, arguing that they should be somewhat of an elongated (very) egg-shape. Has no one anything to say on the proportions and materials of mandrels? Holtzapp., in Vol. IV., is meagre.

Dr. Edmunds's proposed mark on the nose will have one decided good result—the user at once will see if the chuck is screwed home, or if dirt or other obstacle is in the way. Will it have any other good?

Who is responsible for the punctuation in Holt., Vol. IV.? It is perfectly awful.

Will Martin or Greenwood say how they obtained the size of "tapping" hole in their tables—by turning down a bolt, by measuring a drill, or by calculation to the nearest 64th? Also, do they recommend these sizes for cast iron, or what? I have been going through their tables, and have a reason for asking.

I fancy I am outstepping my limits: but if I can only draw one or two letters, our readers will be grateful. **Bow.**

ORNAMENTAL TURNING AND MANDREL NOSES.

[21785.]—I am pleased to see Dr. Edmunds's letter on "Ornamental Turning and Mandrel Noses" in this week's "E. M." From what information I have at present, I am not able to decide either diameter, shape, or pitch to make the nose of mandrel to a lathe I have had in hand for some time. Shall I be asking our friend Dr. Edmunds too much if I request him to give us in the "E. M." the same information that he has given to the A. M. Society; also a drawing of the nose of the mandrel he advocates? I am sure it will be highly valued, and perhaps it may be followed with the replies and conclusions of the members of the above society. I myself wish to complete my lathe with all the advantages I possibly can, and of course it will be a great one to have mandrel nose a standard size pitch and uniform with other amateur lathes. I would gladly buy the number published by the A. M. Society (I have bought some): but as I am a poor man, with other calls for all I can do, I am reluctantly compelled to confess I cannot afford them. Besides, what better place can there be for this subject than our "E. M."? This I have taken from the commencement. However I may have been pinched for twopence, I have always found it possible to get my paper, and I cannot sufficiently say how grateful I am for the information and pleasure I have derived from it. Our contributors cannot tell the good they do, and the pleasure they give to their brother readers who may be poor and sadly in want of the information they are able to give. I seldom trouble our Editor with letters, but I must give my tribute to the good the "E. M." has done me, the many happy hours I have spent over it after my day's work, and also my thanks for the teaching I have received from my brother readers.

By the bye, our Editor must excuse me—but I must tell it. I went on Friday last for my number, and my bookseller said (a retired certificated schoolmaster), "I have just been looking over your "E. M.": there is a lot of stuff in it, but I should say of no use unless you are specially trained—educated, I may say—to understand all these scientific subjects." I said, "You must understand I have taken it from the first number." And the thought struck me, *all these eighteen years, unknown to myself, the "E. M." has been educating me*, so that almost every subject contained in it is more or less understood.

Some time back I asked one of our readers to give some information on the lathe; but he said that he had sent the information to the A.M. Society *for* publication, so could not accede to my request. I was much disappointed, but I hope our friend Dr. Edmunds will see his way to satisfy us regarding this matter. I am afraid that I am presuming too much on space, but I want to ask another thing, and that is how am I to get the exact measure of an inch, or fraction of an inch, in making my lathe nose? I have used a rule all my life almost, and anybody who has done the same knows the difficulty in getting an exact inch from the same. I will be bound in our shop, of from 50 to 100 men, you will not get half a dozen rules the same length. Supposing I wished to make the nose of my lathe to take the same chuck as Dr. Edmunds's lathe will take, can he tell me how to get my standard to measure from (so that he might lend me a chuck or I might lend him one for any particular purpose)? If this is to be done by having a female gauge or standard to fit the lathe nose to, then I can understand; it will be easy enough, but every workman will see the difficulty of chasing a screw to fit a chuck which he has not got to try on. **A Worker.**

PARALLEL STRAIGHT LINES.

[21786.]—Perhaps you can find space in your columns for the following remarks on parallel straight lines.

Euclid's treatment of the subject is less satisfactory than his treatment of other matters. His well-known definition of parallel straight lines, although good as a definition (since it accurately describes the thing defined and excludes all else), involves the use of a tedious and not at all obvious axiom. The general principle in mathematical reasoning is to do with the least possible amount of assumption. This principle is rigidly followed by Euclid. Many of the propositions demonstrated by him are far more obvious than this axiom. For example, any two sides of a triangle are together greater than the third (I. 20) and others.

Various methods of treating the subject have been advocated by different writers. Speaking of these methods, Mr. Todhunter remarks:—"Speaking generally, it may be said that the methods which differ substantially from Euclid's involve, in the first place, an axiom as difficult as his, and then an intricate series of propositions; while in Euclid's method, after the axiom is once admitted, the remaining process is simple and clear."

The following definition obviates the use of a special axiom. Parallel straight lines are such as are in the same plane, and make equal angles with the same fixed straight line.

The angles must, of course, be measured on the same side of the fixed line and on corresponding sides of the others. In other words, they must be the exterior angle, and the interior and opposite angle of props. 28 and 29. There seems no objection to the above definition. The property used is as obvious as that used in Euclid's, and the different props. are as easily deduced from it. It involves the idea of a straight line as direction, and that direction as measured by the angle made with a fixed line. These notions, indeed, being premised, we might define parallel straight lines as those lying in the same plane and being in the same direction. The property involved in Euclid's definition follows at once. For (Fig. I., 28) let A B and C D meet towards B and D, then exterior angle E G B is greater than interior and opposite angle G H D, which is absurd, since they are equal by definition, therefore A B and C D do not meet towards B and D. Similarly, since from Fig. the angles A G H and G H D are equal, they do not meet towards A and C. The props. are easily deduced from the definition. Thus (Fig. I., 27) if the alternate angles are equal, it follows at once that the exterior is equal to the interior and opposite, and therefore the lines are parallel by definition. Again (Fig. I., 28), the angles B G H and G H D are together equal to the angles B G H and E G B. Therefore the angles E G B and G H D are equal, and A B and C D parallel.

If a straight line fall on two parallel straight lines (I., 29), the angles E G B and G H D are equal by definition, and from this it follows at once a

The success of this balance has been very great, a large number of chronometers having been sold to the Admiralty with balances of this description not only bearing the name of Mr. Poole, but of firms that sold his chronometers, who were anxious to possess a reputation attributable to the skill of this artisan. In 1855, an eight-day chronometer by Lawson heads the list; in 1856 Muirhead, with Poole's auxiliary compensation-balance, and, in 1857, a chronometer by Hornby, with a new description of balance, invented by Mr. Hartnup, of the Liverpool Observatory. From the large number of chronometers sent to the Liverpool Observatory to rate, Mr. Hartnup, by a series of experiments, soon found the defective state of the ordinary compensation-balance for a long range of temperature, and further experiments have induced him to conclude that, for a range of temperature of 30°, this error may be confined to very narrow limits in a well adjusted balance.

The balance I am now about to describe (Fig. 9.) was made by Mr. Wm. Shepherd, a skilful chronometer maker of Liverpool, who, in combination with Mr. Hartnup, agreed that the result of their experiments should be made known for the benefit of the public. The results of the discussions with Mr. Shepherd, who made several trials, were concluded by his making a balance of circular form, so that the laminæ of brass and steel might be turned down to the requisite proportions with facility, and that the compensating and poising might be as easily effected as in the ordinary compensation balance. Secondly, the balance must be so contrived that the compensating rim and weights should move towards the centre with an increasing velocity in an increasing temperature, whilst in a decreasing temperature they must recede from the centre with a gradually diminishing velocity. In the engraving, the rim is composed of a lamina of brass and steel, united as in the ordinary balance, the steel of which is bevelled or turned at an angle of 45° or thereabouts. The bar *a*, *a*, with the bars *a*, *b*, *a*, *b*, and also the bars *b*, *c*, are composed of brass and steel united as in the rim; *a*, *a*, has the brass uppermost, and *b*, *c*, *b*, *c*, have the steel uppermost, and they are firmly joined at *b*, *b*. The compensating weights slide upon the rim as in the ordinary balance. Now the effect of the inclined position of the rim is this: The different expansion of the two component strips carries the weights to and fro from the centre, and also up and down in a slanting direction, owing to the bevelled form of the rim. The slant takes off from the action of the rim, but this is increased to the proper amount at mean temperatures by setting the weight more forward, so that the balance is compensated for small changes. So far the new construction acts exactly as the ordinary compensation balance. To show how the balance acts in extreme temperatures, first take the case of extreme heat—the ends of the bar *a*, *a*, bend downwards, and the ends of the bars *b*, *c*, curve upwards; and the compound effect of these two curvatures is to set the bevelled rim more nearly perpendicular to the plane of the balance, whence the effect of the compound rim in bringing the weights towards the centre is greater than it would have been in its more inclined position. Now, this tends to shorten the time of vibration of the balance. In the ordinary construction, a chronometer loses in extreme heat; the new construction, therefore, tends to compensate the losing rate in extreme heat. Again, in extreme cold, the ends of *a*, *a*, bend upwards, and the ends of *b*, *c*, *b*, *c*, bend downwards, from the unequal contraction of the brass and steel strips which compose the bar. The effect of this compound action is to set the rim farther or more nearly parallel with the plane of the balance. Hence the effect of the compound rim will be less effective in removing the weights from the centre than in the ordinary construction, and the balance will move more quickly. A balance of the ordinary construction loses in extreme cold: hence the new balance tends to compensate the error.

Mr. Hartnup found by experiments that chronometers fitted with the new balance are sufficiently compensated in all degrees of heat and cold, and the appended tables were given containing the rates of three chronometers to which these new balances were applied. The temperature ranging from [illegible] the chronometers were tested for [illegible] and extreme temperatures of heat and [illegible] with scarcely any variation. These [illegible] were afterwards tried at [illegible] No. 25, Wm. Shepherd, was purchased by the Government. [illegible] 1857, was tested in [illegible]. In 1858, a chronometer [illegible] heads the list with a new [illegible] with auxiliary compensation [illegible] and third with a range of temperature [illegible]

[illegible] Liverpool [illegible]

In 1860, a chronometer by Birchall stands first, with an alteration of the balance [illegible], W. P. Birchall second, Muirhead with Poole's auxiliary, third, with a range of temperature from 25° to 100°.

In 1861, McGregor, with Poole's auxiliary heads the list, Webb second and third with an unexplained auxiliary to the balance: a range of temperature from [illegible] to [illegible].

In 1862, two chronometers with Kullberg's balances, the first one bearing the name [illegible] and Roberts, the second one the name of the maker, Mr. Kullberg, the third, fourth and fifth chronometers were with Poole's auxiliary compensation: range of thermometer [illegible].

In the year 1863, a chronometer by Fletcher, with auxiliary compensation, heads the list, Kullberg second, Webb third, the temperature ranging from 35° to 97°.

In the year 1864 a chronometer by Kullberg first, McGregor second, with Poole's auxiliary: range of temperature 32° to 97°.

In 1865, a chronometer by Webb first, Lister and Son second, with Poole's auxiliary, Dent third: temperature 32° to 101°.

In the year 1866, a chronometer by McGregor stands top of the list, Cairns second, Poole third, all with auxiliary compensation: temperature [illegible] to 101°.

In 1867, a chronometer by Sewell heads the list, Gowland second, with auxiliary compensation: range of temperature from 30° to 95°.

In the year 1868, Birchall first, Fletcher second with auxiliary compensations: temperature [illegible] to 96°.

In the year 1869, Fletcher first, Whiffen second: range of temperature from 39° to 100°.

In the year 1870, a chronometer by M. F. Dent heads the list, Chittenden second; temperature 33° to 95°. The small error of M. F. Dent's chronometer, in this year of trial, was noticed by the Astronomer Royal to have been the finest chronometer that had ever been on trial, it having made but the small error of 5·5 seconds as the difference between the greatest and the least: and 3·8 seconds; the greatest difference between one week and the next, during a range of 62°. No description of the balance having been given in the published rates, the writer supposes it to have had a balance similarly constructed to the one exhibited by this firm at the Exhibition of 1862, of the following description:—M. F. Dent's new compensation balance, with outside auxiliary bows made much thinner than the ordinary lamina of the balance, the steel being outside and the brass within, reversing the metals for the auxiliary compensation pieces or bows; this gives an increased error which the primary compensation is intended to compensate. The general effect of the balance is that the compensation power is greatly increased in high temperatures. The outside bows are quite free from bankings or check pieces acting upon the balance, which is the principal objection to compensation pieces.

In the year 1871, a chronometer by Charles Frodsham heads the list, with a new reversed balance, performing very nearly equal to M. F. Dent's chronometer in the previous year; temperature ranging from 36° to 94°.

In 1872, a chronometer by Kullberg takes the first place, with a flat rim balance without auxiliary, Hennessy second, McGregor third; these two chronometers having auxiliary compensation to the balance. Temperature 44° to 95°, a range of temperature of 51° only.

In the year 1873, a chronometer heads the list by Wiechert, with Kullberg's flat rim balance without auxiliary, showing the very small error of 3 seconds during any week of trial, and 5·1 seconds as the greatest difference between the greatest and the least. The second was a chronometer by Usher and Cole, Mr. Kullberg's being third; three very fine chronometers! The range of temperature was from 35° to 95°, a range of 60° only.

The balance of Mr. Kullberg is a modification of Mr. Hartnup's and Mr. E. J. Dent's balances, or an improvement on the principle of the balances invented by those gentlemen. It is composed of a compensated disc, the rim and centre bar being all in one piece, thus doing away with the attached centre bars as in the Hartnup balance, and is so constructed that the weights shall act in a straight line to the centre, and has, up to the present time, performed better than any other chronometer at the Royal Observatory, Greenwich. The range of temperature has of late years not been so great, and this accounts for the beautiful performance of the selected few chronometers purchased. This balance does not appear so difficult to make as the Hartnup balance, but it is far harder to construct, and will cost about treble the price of the balance of ordinary construction. How these balances will act in other hands, and in higher ranges of temperature, remains to be seen before it can be said that chronometers with these balances shall surpass all others, as was the case in the last year of trial: the balance with auxiliary compensation performing nearly equal to the first, and surpassing the third chronometer with this new flat disc balance.

In concluding this chapter can give no suggestions for giving the last delicate finish t compensation by any means acting upon the s which for the sake of giving lasting good per ance, must be perfectly free and undisturbe

W. B. Cri

(*To be continued.*)

[51734.]—In reply to "R. M.," No. 217 think he will find his letter fully answered i *Horological Journal* for this month. "R. requires, how came Berthoud to establis matter of certainty that 312 seconds only daily loss was attributable to loss of elas and 62 seconds to increased length, whi neglected breadth and thickness of the b spring. This question certainly mus answered, thus:—That Berthoud was by his experiments, with a chronomet clock carrying a balance under perfect c and with its spring carefully brought to mea say, at 55° of temp. Fah., its rate must hav carefully taken at the starting point, and labour of love of horological art could have him on for the completion of his task; but "R. M." will read the table of the experi chronometer, by Charles Frodsham, as tri the Royal Observatory, Greenwich, and se closely the trials corroborated with Bert experiments, it is all that I can say up subject.

The late E. J. Dent also tried the same ment with a glass *balance* or *disc*, and att 306 seconds or 5 minutes 6 seconds to a l elasticity of the balance spring, and 1min. 1 increase of length. He also tried the same ments with balance springs made with pall and also with gold. I think it is tim the term "pendulum spring" and "hair s are discontinued as far as the bal concerned, for the term "hair spring" to me an absurdity, and the pendulum is the spring, properly speaking, that the vibration of the pendulum. The balance controls the vibration of the balance, and as should be universally called. As to hair spri Yankees are full of it, so much so that the invented a tool for the removal of the hair Certainly the term has a taint of the barber's about it, and I hope our English watchmake think so, and drop the term, and call it the balance spring.

W. B. Cri

REPLIES TO QUERIES

◆

**** In their answers, Correspondents are fully requested to mention, in each instance, t and number of the query asked.*

[50981.]—**Hydraulic Cranes for Ship** *Quetta*, belonging to the British India S. N. fitted with hydraulic winches for cargo; &c., worked by a steam pump and accumu the engine room. The chief advantages a lieve, the saving of wear and tear as c with quick-moving steam winches, and s working cargo at night, with passengers on board.—London River.

[51139.]—**Slide Rule Practice.**—The given by "E. E. S." on page 558, last Vo course, correct; but is the D line in suc necessary or convenient? In a tract (no by the late J. W. Woollgar, a simple No. 117, may be seen:

A | Sp. gravity weight
B | 27·73 cubic inches,

and for bar iron we may use:

A | 10 weight lb.
B | 356 cubic inches.

—J. C. H.

[51157.]—**Tonnage of Steamers.**—T *gravia* is 400ft. long, 44ft. 6in. beam, a deep.—London River.

[51157.]—**Tonnage of Steamers.**—Th dimensions of the ss. *Belgravia* should h given as—length 400ft., breadth 44ft. Si 33ft. Thanks to "Brass Finisher" having called my attention to this matter.-

[51190.]—**Dynamo Construction.**— in the commutator ring is diagonal or order that the current may be taken off and continuously.—A. S. B.

[51191.]—**Bricks.**—How can "Brick" obtain an answer to this query, unless f one who has seen the machine and the T. P.

[51198.]—**Bicycle Wheels.**—There i of "telling" anyone how to put in a lo spokes. It is a case of showing.—E. G.

[51224.]—**Telephone.**—If all the st connected, you cannot ring up one witho the others.—Electro-Magnet.

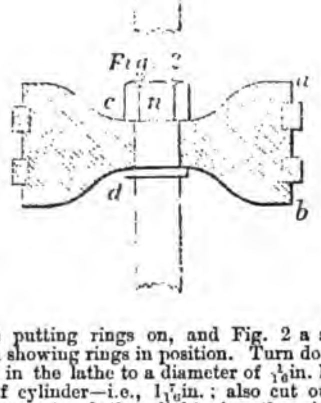
5.]—**Dynamo Machine.**—To Mr. Lan- —My thanks are due to you for so kindly my query (27th July). Will you please me (1) whether the use of 360ft. No. 12 yers) for F.M.'s, and 170ft. No. 16 for Arm. swer my purpose? The R.'s come, I find, t the proportion I mentioned. (2) I pre- should connect magnet in multiple arc. ay yes or no.—A. W. Lambert.

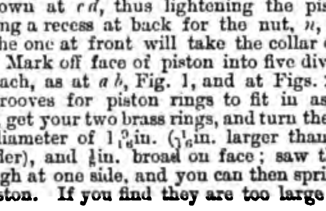
7.]—**Girders.**—The difference between a nd a trellis girder is seen in the following hat in French both are called *poutre en* and in Spanish *viga enrejada*. In Italian, ice is *trave all'Americano*, and the trellis *traliccio*. In German, the lattice is *Gitter-* and the trellis *Fachwerkträger* — i.e., :" means trellis, and "Fachwerk" frame- g. By which the querist will see that the re synonyms; but I think the distinction that lattice applies to iron bridges, and wood; also, that trellis would mean only gonals between two uprights, while lattice nclude many diagonals.—Nun. Dor.

1.]—**Gold Printing on Silk.**—The silk first treated to size—isinglass size preferably hen be printed with gold size on which the aid when it is tacky; or dusted over with powder—which is the usual thing. Neck- not made of silk nowadays; but the best inting is done as above. Better than print- have the letters or designs woven in gold- silk.—C. T.

3.]—**New Zealand.**—Several queries have appeared upon this Colony which do not to be readily answered. With our Editor's ion, I will give the rough impressions I re- luring a 12 months' visit to the colony during On arrival I found that the people did not r things very prosperous. They were g the inevitable period of depression that llow the somewhat reckless spending of the ions borrowed in the English market. s, and nothing but railways, seemed to have e whole absorbing desire; the question of route, or whether they would ultimately munerative, apparently being often totally ded. This condition of things mostly occurs South Island. I much regretted to see that a portion of the loans had been devoted to rnal country roads. Millions of acres are orthless owing to the impossibility of getting . The absurdity of providing costly rail- which mostly follow the coast line) to carry to the ports without the means of bringing luce to the railways, apparently not having 1 to those managing the disposal of the All these things, however, now are re- serious attention. Two experts from l were imported to carry out reforms, and n salaries, which last was no insignificant Space will not permit me to go more into atters; suffice it to say, they are rapidly im- . In answer to "J. B. H.," the "best or wheat and sheep occurs on the plains of th Island, but all of this was long ago p. I understand, however, that many e sheep runs on these plains let se are now falling into the hands overnment; these will be cut up into all ocks for large and small farms, and is t land. Particulars of present prices, &c., doubt be obtained at the Agent General's Westminster. Bush land (that is forest n be obtained in the North Island from acre, sometimes less, according to position. n will contract ordinarily to "fall" at 25s. , and a like sum will sow it down in grass. e the timber is all burned on the ground, has lain some months to get thoroughly The resulting huge charred trunks and s have to be split, heaped up, and re-lit, cess being repeated till all is gone. The are usually allowed to rot, which they do years. The grass seed is sown as soon as nd cools after the first burning, and springs luxuriantly. Fencing is an expensive and ome item, many forms are in favour; but no doubt when you have the timber on the substantial post and rail fence will pay in . A single stretch of barbed wire, to dis- cattle rubbing, will be found a good . A party of young men fond of hard ill find great interest and novelty in this lthough the destruction appears ruthless, satisfactory to note the daily increase to the , generally, at first to let in more sunshine ut or whare (pronounced wharry). Wild d boars can be hunted in most parts, the of birds of all kinds being most abundant. inland the North Island come the tu plains, an immense area; owing e difficulties not much has been done em. As a public company is now ing a railway right through these the native trouble will not long be heir objection is merely a protest on their eir power being gone. These plains are , and though the vegetation is very fair, the ground will not be so productive as the cleared bush land, though on the other hand the time and expense of clearing will be saved. The active volcanic region of Tongariro lies about the centre of these plains (see page 515). Our party attempted the ascent of the volcano, but failed owing to the unfavourable wind blowing the sulphurous fumes down the mountain side. The streams were found to be heavily charged with chemicals, which was not altogether a pleasant discovery, as the sulphurous dust is very thirst provoking. This region is certainly one of the most wonderful in the world. Geysers, hot-springs, mud volcanoes, &c., abound over a large area. One native village we visited on the shores of Lake Taupo seemed to be situate on the crust of an immense subterranean high-pressure boiler, steam and water were escaping in every direction. All cooking was performed by its agency. I also saw two natives busily scraping a pig in a boiling hole, and from the accumulation of hair it seemed to be the usual village resort for this purpose. Potatoes put into the steaming earth were excellently cooked in 20 to 30 minutes. Large pools of every temperature existed, some of high repute amongst the natives for their curative properties; every evening they bathed together, and seemed to enjoy the advantages they possessed for cleanliness. Though my stay in N.Z. was short, I saw enough to convince me that anybody with a knowledge of a definite trade, such as joiners, plumbers, smiths, masons, &c., need have no fear of not doing well in New Zealand. It is the young man of superior education, but without a profession or capital who fails in New Zealand. The demand for bankers' and merchants' clerks is more than supplied; the rest have to work, and very menial work, too, sometimes. The rates for money are just now high—10 per cent. for small sums up to £500. The flow of money to England for machinery and merchandise is extensive; the want of manufactories seeming to be great. Immense sums are annually spent in importing such things as jams, sauces, matches, &c. As regards climate, the country lying north and south, any desired variety may be had, from the semi-tropical of the Bay of Islands to the degrees of temperature experienced by Cornwall or Devon in the south island. The seasons are far more regular than in England. Its mineral wealth is only in the elementary stage of development. Any further information will be cheerfully given. —Imprimatur.

[51301.]—**Metallic Piston Rings.**—I think "Cylinder Bore" will find the following a simple and good method of making his piston and rings, and is same as used for locomotives on Ramsbottom's principle:—Fig. 1 is a plan of piston before putting rings on, and Fig. 2 a sectional sketch showing rings in position. Turn down your piston in the lathe to a diameter of $\frac{1}{16}$in. less than bore of cylinder—i.e., $1\frac{7}{16}$in.; also cut out metal as shown at *c d*, thus lightening the piston and forming a recess at back for the nut, *n*, to fit in, and the one at front will take the collar of piston rod. Mark off face of piston into five divisions of $\frac{1}{8}$in. each, as at *a b*, Fig. 1, and at Figs. 2 and 4; cut grooves for piston rings to fit in as shown. Next, get your two brass rings, and turn them down to a diameter of $1\frac{9}{16}$in. ($\frac{1}{16}$in. larger than bore of cylinder), and $\frac{1}{8}$in. broad on face; saw the rings through at one side, and you can then spring them on piston. If you find they are too large to press into cylinder, file a little of the cut ends, and make them so that you can just press them into your cylinder with the ends meeting. You will find, by making the rings larger than bore of cylinder, that they will have plenty of spring against side of cylinder, having a tendency to press outwards to their former size; and if the sawn ends of the two rings are placed on opposite sides of piston little or no steam will pass them. The rings need no scraping. Make piston rod with a collar on to fit against piston, and a thread at the end to take a nut; and, if you choose, you can drill a small hole through nut and rod, and put a small split cotter through to prevent nut turning.—W. E. G.





[51301.]—**Metallic Piston Packing.**—If the casting which forms the rings is well hammered on a mandrel before turning and boring up, you will find that the rings will expand sufficiently for your purpose after being sawn open. The reason why the rings are best turned up a little eccentric, is that the part which wears must have most metal to spare, and, as the rings usually wear on the side where the saw-cut is, it is best to have the thick part there. I regret that the drawing I sent of the piston shows the groove too deep. It should just be deep enough to allow the thick part of the packing rings to rest against, so as to prevent the steam blowing through to any serious extent. The rings can easily be taken out and examined by simply unscrewing the nut and taking the covering disc off. If the lid of your cylinder is turned out to receive the nut on the piston-rod, you need not fear any serious damage from the nut coming off, for, as soon as the nut gets a little loose when at work, it knocks against the cylinder cover every stroke, and gives warning by the noise.. I have only had one become loose once, and that was my own fault in not screwing it up properly after cleaning. It is a good plan to lighten pistons as as much as possible where the strength is not required, as the weight of the piston, piston-rod, and connecting-rod make a marvellous difference in the speed and wear of the engine when running a high number of revolutions per minute. Don't use solder to fix the piston to the piston-rod—it makes a tinker's job at the best, and solder has not a bit of strength for such a purpose. When the engine is at work the steam seems to take all the holding nature out of the solder, as I have experienced lamentably, and only use it when required where it will not be subject to any heat. While on the subject of packing, I may say that lately I have been trying asbestos fibre as a packing for the piston and gland of a 2in. bore trunk engine on a 5ft. model steamer, and it answers the purpose so well that I intend using it always instead of the usual cotton packing. It reduces the friction considerably, and always keeps steamtight and does not rot.—S. Austel.

[51327.]—**Angular Velocity.**—I am greatly obliged to the correspondents who have written on this subject (by the way, I suppose "J. H." means "Principles of Mechanics," by T. M. Goodeve, M.A., which is reviewed in your issue of the 24th August), but not any give me the information I want. I have, and can get the proper weight for an engine flywheel, or rather, I should say, I have got the weight of wheels that are now actually running, and doing their work well; but some of them may probably be theoretically wrong. Nearly all the writers I have consulted vary in their rules for the weight of flywheels. Let any reader try to get the weight of the rim of a wheel by, say, Molesworth, Burgh, Bourne, and Rigg, and then compare the results. I think he will find them rather confusing. Angular velocity is a term that was not used when I learned my trade, and what I want to know is, is it a shorter way of getting out or calculating the stored up energy of a revolving body like a flywheel, or can the proper weight of flywheel for any engine be got out in less time than by other methods used? Perhaps it will make my question plainer if I give an example from practice:—An engine has an 18in. cylinder, 3ft. stroke, 50 revolutions per minute, 12ft. flywheel, is driving a steady weight with 80lb. pressure in boiler, say, averaging 50lb. on diagram. What weight should the flywheel rim be to carry her round three times after the steam is shut off, all the load to be kept on? I have no doubt it will astonish some of your practical readers to know that the specified weight of flywheel for above was 10 tons, and the rim does weigh $7\frac{1}{2}$ tons.—Tyke.

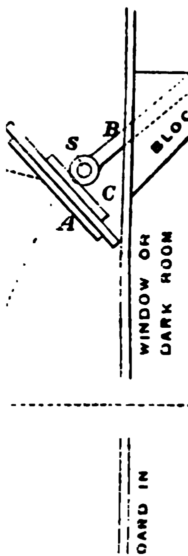
[51337.]—**Air-Pump.**—"J. W." is right, I really meant air-pump. The pipe recommended should branch out below the air-pump cover and project upwards, say, 1ft. high. If it is an open-top hotwell over air-pump, the pipe can be carried up and turned over into top of hot well, as a means of keeping surroundings dry, as a little water may occasionally be carried through the pipe.—Boswell.

[51346.]—**Clarionet.**—"A., Liverpool," in answer to this question, says "the bell-mouth only increases the loudness," and I take it to mean that it increases the loudness of tone throughout the instrument, and I think it misleading, for if the bell increases the

rt of the instrument, it is the
ir harmonics or twelfths. I am
that even these notes are in-
he bell; but I am sure that they
rpened when I take the bell off.
to the conclusion that the bell
nore to do with pitch than it
r "loudness." So far as the
d, which are produced from
alf of the instrument (or indeed
u may play them with the bell
l I think you will not be able to
in either pitch or timbre. I
easurement given by "A." to
$\frac{5}{16}$in. for the bore; at any rate
J. D.," or anyone else, not to
with a bore any less in diameter
, which is nearly $\frac{5}{16}$in. Seeing
s asked for information on the
and reed (which I have every
will get), I would like to see
nethod of making a mouthpiece
h a beechwood reed, than an
4d. Spanish reed. No doubt this
g to others, and if it turns out to
a boon to all connected with
Blowhard.

ving Cream.—I fear "A. E. S."
nderstand my question. I do
eam for a day or two by the
acid: my object being to pre-
r any length of time in hermeti-
nilar to condensed milk or pre-
oups. Is it possible to exhaust
ithout raising the contents to
oramus.

tat.—"Warragul" does not
f heliostat he requires. The
one I made for getting a beam



here I wanted it. A A, pieces
or fastened to pieces of pine
½in. iron rods, on which are
c c, to which the reflectors are
ors are kept at proper angle by
w s.—C. R. T.

Reeds.—I must first thank the
who have written about the
here is no doubt about bending,
difference to the tone of the
is applied. Nevertheless, it
harshness when the reeds are
onclude there is something else
ount. But why not, if it does
the same principle to the bass
sure, want it as much, if not
er notes? But "Baffled One"
troubled with his steel reeds.
d an instrument with them for
nd never had one break from
reeds generally break because
them, coming from using rolled
h are almost sure to be imper-
erceptible for some time. The
fer than brass, and so may be
lse an increased weight of wind
sed the ordinary organ bellows,
kes a difference. For instance,
great deal better by putting an
n the bellows. I must say I
they give a more regular sound
ugh many in the usual way of
ium would not notice it. There
he steel reeds which I have not seen noticed: they must be polished and blued, or they will rust. Now if you tune them after they are blued you must take this off, and so make them easier to rust, and then if you were to tune very thin reeds you reduce in time their strength and thickness. To avoid all this I melted some wax and rosin to a proper thickness, and melted a small quantity on the end of each reed, and did the tuning by adding to or taking from the composition, thus avoiding meddling with the reeds at all, and found it an extremely good plan.—Edwd. Thos. Scott.

[51425.]—**Ash of Coal.**—Thanks to "A. E. S." and W. E. Haden. I do not wish to have an exact analysis; I merely wish for a general reply, so that I may form some idea of the effect of coal ash on garden soil. For my purpose the coal may be assumed to be what is sold as Wallsend in London, or Silkstone, as those are the principal coals ordered. Sometimes we find large pieces of what we call "slates" for want of a better term, but the great bulk of the ash is greyish white soft substance, the composition of which I wish to know very roughly.—E. G.

[51432.]—**Clarionet or Oboe.**—Of these two instruments, I would recommend the clarionet to "Woster" as the one most likely to satisfy him. Although the oboe is a sweet instrument when well played, it presents difficulties in the management of the reed (the one thing essential for the production of a good tone) which appear almost insurmountable to many beginners on that instrument. If he had a C he would be able to play violin music with a piano; but, solos with accompaniments are written either for B flat or A, and the B flat clarionet is generally acknowledged to be the best solo instrument. Correspondents of the "E. M." who contemplate making these instruments, will not, I am afraid, be very successful. A clarionet with joint close up cannot be sharpened, and when drawn much in order to flatten it, the whole instrument is thrown out of tune. To obviate this a new one has recently been brought out, which, by the action of a slide, shifts all the holes; but I do not know whether it has proved satisfactory. There is one very mysterious wrinkle in the "set" of a mouthpiece. Reeds are made of various thicknesses to suit different players, and if too hard can be refined (or made thinner) by rubbing with "Dutch rush." "J. J. I. D." speaks of a small F clarionet. I have never yet heard of one. They are made in E flat, A, C, and B flats.—Clarion.

[51432.]—**Clarionet or Oboe.**—In "J. W. C.'s" reply to "Woster" (vide p. 608), the former states "the extremely nasal tone of the latter (i.e., oboe) would be objectionable in a drawing-room." Is not this assertion rather too sweeping? I am totally ignorant of clarionet playing (I mean the difficulties, &c., to be surmounted), but have been an oboeist for the past twelve years, and can certainly say that in my opinion, and in the expressed opinion of many others, there is nothing whatever objectionably nasal in the tone when once the proper method of blowing is acquired, and suitable reeds obtainable. About this latter it is a *sine quâ non* that the player makes his own reeds. Very little manual dexterity is required, and the operation is a delicate and pretty little piece of work. The reed that would suit one player would, perhaps, prove utterly useless to another, and *vice versâ*. I find that rather broad reeds of a dark or mottled colour, and carefully voiced, will produce a tone approaching the flute for sweetness in the upper registers, and equally charming (to my ear) in the lower. But as we are told that there is one glory of the sun and another glory of the moon, so there is one glory of the clarionet and another glory of the oboe. Both these instruments, in the hands of a thorough master, are capable of charming the ear of a listener by their beautiful qualities of tone; but much the same can be said of most other musical instruments in the hands of talented soloists. Whether "Woster" selects clarionet or oboe, he must be prepared to endure the torture of hideous noises for the first two or three months, and must put up with the animadversions of his near neighbours. Don't attempt to learn from a book alone, but get a competent master at the very first, and so avoid risk of acquiring bad habits difficult to eradicate subsequently. The oboe, like violin and flute, stands in C, i.e., you can play from any piano or voice music written in treble clef without transposition. I suppose the same could be done with the C clarionet; but I have understood from various sources that the C clarionet is an unsatisfactory instrument. I never could get at the philosophical bottom of this, although I have tried over and over again, so must be content to leave it among other things that "no fellah can understand." Finally, "Woster" must not be too much influenced by what he hears of the playing of either of these instruments in bands, unless they are very fine military or orchestral bands. As to the oboe, it is essentially an indoor instrument, and always, in my opinion, sounds very poor and thin in the open. The oboe can be flattened or sharpened within very narrow limits, but is supposed to be pretty well *fixed*, as all orchestral bands tune (in the absence of an organ) from the first oboe's A, 2nd space treble clef.—O.

[51437.]—**Preventing Springs from Rusting.**—Would "Glatton" (see page 608) kindly inform us how he would prevail upon the springs to "keep their temper" whilst undergoing such a process of "blazing off" several times? Why won't paint or varnish keep off the oxidation, or why can't they be "oxidated" with pure tallow?—A., Liverpool.

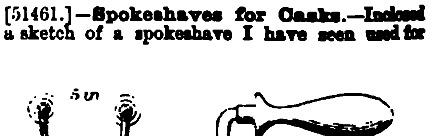
[51438.]—**Mathematical.**—Tan^{-1} $\frac{a+bx}{a-bx}$ is either a misprint (I see you have it tan^{-1} $\frac{a+bx}{a-bx}$ in one place) or a slip of the pen on my part. If the latter, I owe an apology to your correspondent. It should be tan^{-1} $\frac{a+bx}{b-ax}$.—G. W. Bulman.

[51439.]—**Laundry Stove.**—If "Economist" lives where gas can be obtained, he should abolish his stove, and use gas-heated irons. Apropos of the question of examining patents it is worth mentioning that the *Scientific American* of August 18 last contains an illustration of a gas-heated iron, which is called an "invention," patented by Mr. Pedder, of Galveston. It is one of the crudest forms, the mixture of gas and air entering at the top of the iron, and no provision being made for reversing the latter. Much superior forms have been used, to my knowledge, for more than six years in many houses in the City, and one was shown in action at the Gas Exhibition at the Palace. So common are they that in advertisements for ironers it is usual to see the words "gas-irons." I believe that patents were taken out for these irons in the United States; but in spite of that fact the system of "examining" allows of a crude device being patented when better ones are already well known.—Nun. Dor.

[51451.]—**Star Mapping.**—In answer to this, a map on the conical projection supposes a cone placed on a celestial globe, so as to touch the central declination parallel, the apex being over the pole. Then the other parallels and meridians are projected upon cone, as if seen from centre of globe, and the stars filled in in the same manner. I think "R. K. P." will see, then, that everything is supposed to radiate from the apex of the cone, the meridians being straight lines. Having once put in the pin, it remains fixed for each map. Of course, a small amount of distortion is inevitable; but so it is in any attempt to delineate a sphere, or a portion of one, upon a flat surface. I am sorry to say my knowledge of star catalogues is not sufficient to enable me to recommend one containing all stars to the 5th mag. What about the B. A. C.? I should think Mr. Franks could answer this question as well as anyone. There is a catalogue of 1,500 in Proctor's handbook, and a good deal of other information on star mapping. My plan has been to copy the stars from Proctor's large maps first, and then add from "Celestial Objects." The drawback is that there are thousands of stars visible to the naked eye not included in the maps, and it is often troublesome to tell with an altazimuth which is the particular one required. If, however, the distance of the components exceeds 1·5", a Kelner e.p. of 80 or so takes in a large field, and indicates a peculiarity about the star, if it does not divide it. A series of diagrams of stars showing the field of difficult objects would be very valuable to the amateur.—Edwin Holmes.

[51459.]—**Collapse of Tubes.**—Correction.—The 20th line in my answer to above query should read: "Bolton steel hoop seams 3' 0" (3ft.) apart, &c.," not 3in., as shown in answer.—Boswell.

[51461.]—**Spokeshaves for Casks.**—Inclosed is a sketch of a spokeshave I have seen used for



inside of casks, something like a drawing-knife, only a circular blade. The knife is ground on the inside. A is the cutting edge.—T. W.

[51481.]—**Spurious Coin.**—Draw the edge of genuine coin across the face of a doubtful one; if spurious, it will be deeply cut. On the other hand, a spurious coin will make no impression on a genuine one. Or, moisten the coin, and apply a little lunar caustic; the spurious coin will be blackened at the point of contact. (Nitrate of silver is also a test for gold; but if an article is plated, a little scraping may be necessary to detect the fraud.) Some bad coins are really good imitations. I know a pawnbroker who has b
in five times in the course of fourteen
at night. I think "Os." was wro

s coins are mostly made of zinc. I have ore me now in which I can find lead, tin, imony ; but not a trace of zinc. Thanks to ss for his Al plate reactions, I can detect in one minute.—Ex-Blacksmith, Gorton

4.]—**Reed Organ.**—The questions put nder this heading would require a consider- iount of space to reply to definitely. How- will now reply to that which I think ry, and leave the rest to the judgment of the . It is quite possible to obtain a sufficient of tone from reeds to build a three manual lal reed organ, but a considerable amount of e and skill will be required in voicing the n order to produce a sufficient variety of eristic tone in the various stops. I may add e firm of Messrs. Mason and Hamlin have rought out a three manual pedal reed organ ; ave not as yet had the pleasure of hearing or this particular class of organ. G. Minor his organ to contain 20 rows of reeds. Does n rows of 2½, 3, or complete sets of 5 octaves As regards the metal for the reeds, I, for n part, should prefer those made of brass for easons. Taking all things into consideration, nion is that brass reeds are the best, provid- course, the metal is really good. I should y advise the querist to build his organ on tion principle, and buy his tubeboards fitted he reeds unvoiced, he will then be able to e reeds voiced to his own liking, and if he ever attempted the art, I should urgently him to get somebody that knows how to do him. Under such circumstances, this will great amount of trouble, time, and incon- e. Various specifications could be suggested arrangements of the reeds and stops for the ls. For my own part, I should set aside one l for solo performances, having the reeds to produce certain characteristic qualities , such as the clarionet, trumpet, kalophon, , flute, &c. Either of the manuals could be r this purpose, but I should prefer the lower l. For the pedals, I should have two rows . reeds, one voiced soft and the other set and also one 8ft. set voiced rather soft to the ordinary diapason. These sets may con- 30 notes each, which I think will be suffi- Before advising further I should like to how many sets of reeds are required to each tive manual, and of what compass, whether 3, or 5 octaves. The query is not sufficiently e on these points. Will any couplers be ed ?—G. Fryer.

92.]—**Burning and Painful Feet.**—Put eet for half an hour in bran and hot water going to bed, and at any time during the hen painful. Use plenty of bran, and make ot as you can bear, and persevere with it. ou will, I think, find an effective remedy ; , write again, and another one shall be given he Kent Hermit.

93.]—**Laundry Stove.**—Have a damper in e to regulate the combustion of the coal. If ere to use coke, I should think it would heat rons quite as well. No arrangement of gas atus in connection with the present stove be so economical as burning coke and ting combustion by a damper in the flue.— stel.

97.]—**Small Brace.**—What this querist was illustrated on p. 547, Vol. XXXV.— Dor.

97.]—**Small Brace.**—E. Owen will find ll Archimedean screw brace quite suitable. from 2s. at any toolmaker's or ironmonger's. H. F.

97.]—**Small Brace.**—I have drilled a er of small holes in metal with a small medean drill. It consists of a wooden handle hich fits one end of an iron rod about 9in. nd has a coarse worm or thread cut in ; at the end of rod is the socket for drill to fit in. A fitted to the rod, shaped like a spool, and by ; this up and down the rod and drill rotate y. I bought brace and three drills for 6d., cheaper than you can make one, and I think l answer your purpose very well.—W. E. G.

98.]—**Seaweed.**—If E. Owen will advertise ldress, I think I may be able to tell him a cal use for seaweed.—Onward.

98.]—**Seaweed.**—Could E. Owen send us, bout 1cwt. of seaweed for trial ? We think n put it to practical use. We will pay ge and cost if not very far.—William Atlas Works, Bacup.

98.]—**Seaweed.**—The reply to this query ds on the kind of weed plentiful, locality, The weed called "carrageen moss," is used ke a kind of tea for consumptive patients. n other kinds are dried and utilised for the g of cheap furniture. Seaweed used to be yed in glass manufacture, but has, I believe, been supplanted in a great measure ; and, lastly, seaweed makes very fair manure for many things. —B. H.

[51500.]—**Mathematics.**—(1) Area of base = 10 × 11 = 110 sq. ft. ; area of top = 5 × 5 = 25 sq. ft. ; average area = 110 + 25 ÷ 2 = 67½ sq. ft. ∴ cubic contents = 67½ × 5 (height) = 337½ c. ft. ; (2) Area of base = 20 × 10 = 200 sq. ft. ; area of top = 15 × 5 = 75 sq. ft. ; average area = 200 + 75 ÷ 2 = 137½ sq. feet ; ∴ cubic contents = 137½ × 5 (height) = 687½ c. ft.—Salvo Jure.

[51500.]—**Mathematics.**—

ft.
10ft. × 11ft. = 110 square of base.
5ft. × 5ft. = 25 square of top.

2) 135

67·5 mean square.
67·5ft × 5ft. height.
5

337·5 cubic feet in (1) heap.
In (2) heap 687·5 cubic feet.—G. H. F.

[51500.]—**Mathematics.**—In reply to "Poor Labourer," I beg to submit the following figures as the correct method of solving his problems:—

ft. in.
(1) 10ft. 0in. × 11ft. 0in. = 110 0 area of base.
5ft. 0in. × 5ft. 0in. = 25 0 area of top.

135 0 ÷ 2ft.
= 67ft. 6in. × 5ft. 0in. = 337ft. 6in. cube.
ft. in.
(2) 20ft. 0in. × 10ft. 0in. = 200 0 area of base.
15ft. 0in. × 5ft. 0in. = 75 0 area of top.

275 0 ÷ 2ft.
= 137ft. 6in. × 5ft. 0in. = 687ft. 6in. cube.—Evans, Dublin.

[51500.]—**Mathematics.**—

ft. ft.
$$10 \times 11 = 110$$
$$5 \times 5 = 25$$
$${}^{2}\sqrt{110 \times 25} = 52{\cdot}44$$
$$187{\cdot}44$$

$(187{\cdot}44 \div 3) \times 5 = 312\frac{2}{5}$ cubic feet. Ans. No. 1.

ft. ft.
$$20 \times 10 = 200$$
$$15 \times 5 = 75$$
$${}^{2}\sqrt{200 \times 75} = 122{\cdot}47$$
$$397{\cdot}47$$

$307{\cdot}47 \times 5 \div 3 = 662\frac{9}{20}$ cubic feet. Ans. No. 2. —A. McCormack.

[51505.]—**Land Tax.**—The poor rate is the usual basis. You can appeal to the Commissioners at the proper time. You will then have to prove that the property in the parish is unequally assessed, and that yours in particular is over-assessed—that you are assessed on the gross rental instead of rateable value. It is desirable to redeem if the property is likely to become more valuable. The rule is: "the money paid be sufficient to yield interest less by 17½ per cent. than was required by Act 42, G. III., c. 116." The sum to be paid depends upon the price of Three per Cents in the week after the contract. For fullest details see "Land Tax and its Redemption," by W. Evans, a copy of which appeared in the *Estates Gazette* (Fetter-lane) about two months since ; I do not remember the date. Roughly, the sum to be paid is 20 to 30 years' purchase.—R. Hannen.

[51506.]—**Earth Contact.**—Your cheapest way to form an earth circuit will be to solder your return wire to a gas or water pipe ; if you have not got either, get a thin copper plate 16in. square, solder your wire to that and bring it a few feet under the surface in damp soil. That will be cheaper than using a return wire.—Fitter.

[51507.]—**Model Compound Marine Engine.** —I doubt if a model of the size you name would work well without a good deal of attention to the boiler steam pressure. I don't think you will get the necessary steam pressure, say, 80lb. on the square inch, unless you use a very good boiler, which would come expensive, and may possibly prime ; and, as a consequence, upset the proper expansion in the cylinder. 2 to 1 is the proportion generally used in large engines ; but as you, in all probability, will not have enough pressure in the small cylinder for the necessary expansion in the large ditto, I should recommend your making the proportions 1½ to 1. You will find it more satisfactory to have two cylinders 1¾in. by 1¼in. to your engine, and work both direct from the boiler. I presume you are not thinking of economising the fuel in the model in question.—S. Austel.

[51509.]—**Rabbits.**—Your rabbits are just the age for breeding. A very useful book entitled, "Pigeons and Rabbits," by E. S. Delamer, price 1s., is published by G. Routledge and Sons, London. —J. E. Norman.

[51509.]—**Rabbits.**—"Pigeons and Rabbits," by E. S. Delamer (1s., published by Routledge), is a good book. The author says that rabbits breed before they are six months old ; but this is the earliest age at which they should be allowed to do so.—R. A. R. Bennett.

[51516.]—**Commercial Units and Metallic Ores.**—"Pyrites cupreous 6d. per unit c. i. f., G.B." For an example take Rio Tinto pyrites. These contain on an average about 47 per cent. of sulphur. Every per cent. in a ton is called, in commercial phrase, a "unit": therefore the price of the sulphur in a cargo of Rio Tinto pyrites which was found by analysis to contain, say, 47 per cent. of sulphur, at 6d. per unit, would be 47 times 6d., or 23s. 6d. for every ton of pyrites. The copper in cupreous pyrites is sold quite distinct from the sulphur, and the price is calculated on an altogether different basis; "c. i. f. G.B." means that the merchandise is delivered by the vendors, all cost, insurance, and freight paid to any port in Great Britain. "c. i. f." is sometimes written "c. f. and i.," and instead of "G.B." it is often put "U.K.," or United Kingdom.—Rio Tinto.

[51517.]—**Compressed Gas.**—Cubical space occupied by gas varies inversely as the pressure, so by a rule-of-three sum you get cubical contents. Taking initial pressure of gas same as atmosphere— 1728in. : 15lb : : 1,000lb. :—Ans. — 8·6 cubical inches. I should think you will require some kind of a reducing valve on your reservoir to make gas burn.—W. E. G.

[51519.] — **Chemical Action of Etching Copper.**—When chlorate of potassium and hydrochloric acid are mixed together, a body is produced, which Davy termed euchlorine, but which is probably a mixture of chlorine tetroxide and free chlorine. These acting upon the copper form a chloride, which then combines with the chloride of the alkali, produced by the action of the HCl on the $KClO_3$, giving rise to a double salt. With nitrous acid, which is the term applied to the impure nitric acid of commerce, nitrate of copper is formed.—W. E. Haden.

[51520.]—**Granule Carbon Battery.**—I think you will find, by using ammonium chloride, acidified with hydrochloric acid, instead of the Zn chloride, which forms a hard yellow incrustation on the Zn, that your mistake will be rectified. I myself have worked it for thirty hours at intervals, and at one time.—Hugh.

[51520.]—**Granule Carbon Battery.**—I have three cells, "granule," about same size as "Hill's," and find them work well charged as follows:— Outer cells: ¼lb. bichromate potash dissolved in about half a gallon of warm water. Cool, and add about one-third of a gallon of muriatic acid. Inner cells: place in each porous pot 2oz. chloride ammonium mixed to paste with ½oz. muriatic acid, and fill up with water.—G. H. F.

[51521.]—**Opening Railway Bridges.**—There is a swing railway bridge on the Manchester and Stockport railway over the canal at Sankey, and it is proposed to use these bridges over the Manchester ship canal, near Warrington.—W. E. G.

[51524.]—**Trembling, &c.**—This case can only be prescribed for after personal examination ; so consult a doctor. If you have not received benefit from medical advice, the reason is probably that you either did not strictly follow that advice, or that you did not sufficiently describe the particulars of the case, and your habits and mode of life. I am sorry I cannot assist you ; but you would, no doubt, derive much benefit by adopting the anti-indigestion diet given in a recent number of this journal. —The Kent Hermit.

[51525.]—**Magnetism—Science Examination.**—Have you got Buckmaster's "Electricity and Magnetism"? If you have not, you ought to get it, as it is written expressly for the science and art students. I don't know any book entirely composed of answers to questions given during past years. There are plenty of advanced questions in Buckmaster ; or you can get all the questions set in former years from the secretary of the Science and Art Department, South Kensington, S. W.— R. A. R. Bennett.

[51525.]—**Cram-Book in Subject IX.**—I have taken the liberty of altering the title of this very unsatisfactory query, and beg to inform "R. R. R." that I believe there is such a book as he desires, but I decline to advertise it. If he wants to pass an examination he should study the subject properly. The existence of such books as the one inquired for has done more harm to science teaching than can easily be estimated.—Wm. John Grey, Elswick Science School.

[51526.]—**Cement.**—"Coaguline" answered very well.—R. A. R. Bennett.

[51527.]—**Sulphate of Copper.**—When I answered this question before, I was under the impression that brass would dissolve quite easily in sulphuric acid. On actually trying it, however, I find that it is a good deal of trouble to get it to

[illegible] If [illegible] thermometer [illegible] water. [illegible] will get splashed [illegible] whether [illegible] sulphuric [illegible] Couldn't [illegible] in a very [illegible] if heated [illegible] quicker.—R. A. R. [illegible]

[51634.]—**Stern Wheel Steamer.**—[illegible] could get some of [illegible] favour [illegible] cylinders with [illegible] horizontal, and drive the wheel [illegible] best size and position of the wheel [illegible] motion is already [illegible] therefore it should be nearly as wide as the boat, as to putting it out of sight [illegible] over it, but [illegible] very large wheels placed on a frame extending from the stern.—T. P.

[51635.]—**Moisture in Air.**—[illegible] ploy a wet and dry bulb thermometer [illegible] g the moisture from [illegible] the formula given in Ganot's "Physics."—[illegible] ART.

[51635.]—**Moisture in Air.**—This can readily ascertained by means of Daniell's hygrometer, and these are supplied with instructions for use. It is edless to give them.—W. E. HADEN.

[51542.]—**Boro-Glyceride.**—Full particulars of arff's preservative will be found in VOL. XXXIV., 367.—NUN. DOR.

[51542.]—**Boro-Glyceride.**—This is prepared heating boracic acid with 1½ times its weight of ycerine; when entirely dissolved, and allowed to ol, it forms a tenacious deliquescent mass, soluble water and spirit. In solution it is used as an tiseptic for preserving meat, &c., and also for rgical dressings.—W. E. HADEN.

[51550.]—**Colouring Baskets.**—Wouldn't dson's dyes answer your purpose?—R. A. R. ENNETT.

[51551.]—**Chimonanthus Fragrans** is of order olygynia, in class Icosandria. It is sometimes lled the Japanese Allspice. It is multiplied by yering. The leaves fall about November, the llow flowers appear at Christmas time, and have very fragrant odour. It was brought over to this untry by Admiral Harvey about eighty years go; it grows out in the open—a light soil with uthern aspect suits it best. The leaves may be cked in the summer or autumn: it will not imde the growth. Dry in the sun, roll up, and d pack tightly down in a box in a dry place, so to obtain the ripeing; use as tea.—A LOVER OF EAN FOOD.

[51554.]—**Preserving Butter, Fish, and oultry.**—After repeated trials, I find the best ticle for the above purpose to be "Conservealait."—J. E. NORMAN, Worle, Somerset.

[51556.]—**Utilising Oxide of Tin.**—Oxide of n is used for polishing plate, under the name of tty powder. By fusing it with excess of caustic da, stannate of sodium would be formed, which used as a mordant by dyers; or it may be reduced the metallic state by fusing with charcoal and dium carbonate.—W. E. HADEN.

An Installation of Electric Power and Light.—At Archway House, Bush-lane, Cannon-street, E.C., Mr. C. R. Heap, the agent for the [illegible] Company, of Philadelphia, has [illegible] a small installation of electric power and lighting by means of Kabath's storage batteries charged by the current from the mains of the Metropolitan Brush Company. On any day of the week from, say, 10 to 4, Mr. Heap will be pleased to show what can be done by means of electricity in lighting the apartments of a house or in working [illegible] machines, or the appliances of an amateur [illegible] workshop. The excellent little Griscom motor which attracted so much attention at the [illegible] can here be seen driving sewing machines, [illegible] drilling machines, ventilating fans, and last but not least, a dentist's drilling apparatus [illegible] arranged that the motor and [illegible] desired position, the drill [illegible] a flexible shaft. We have [illegible] Kabath's secondary cell [illegible] XXXV [illegible] as modified and improved [illegible] Archway House, just as it [illegible] a dwelling-house. [illegible] is well worth a visit by [illegible] the utilisation of electricity for [illegible] power.

UNANSWERED QUERIES

[illegible]

[illegible]

[illegible]

QUERIES

[illegible]—**Chemical.**—Will some kind friend [illegible]

[illegible]—**Nickel Plating.**—I shall be glad of any hints on above. In making a solution and batteries I have been guided by instructions given in Watt's "Electro-Metallurgy." I made a solution of sulphate of nickel neutralised with ammonia, and added a solution of sulphate of ammonia neutralised with H_2SO_4, in each case pure. I made merely a small quantity for experiment, say about a pint, but I should say the proportion of metal would be [illegible]. From this solution I have obtained no result whatever. No deposit—good, bad, or indifferent—is made. I have also tried a solution spoken of in Watt's work consisting of sulphate of nickel, tartaric acid, and potassic hydrate, but with a like result. I have two batteries each consisting of a jar about 1gal., containing a cylinder of copper, and a porous cell containing a zinc bar. Dilute sulphuric acid [illegible] in former, and concentrated solution of common salt acidulated with HCl in the latter. The connections are all right. The amount of anode exposed exceeds the surface to be deposited upon, which I have taken care to have thoroughly cleaned. I have first tried one cell, then two, arranged both for quantity and intensity. There is evidently some necessary condition omitted, and I shall be obliged if any correspondent would suggest it or recommend a well tried solution. I wish to make a bath of about 1gal., as I have a tank of that capacity. Will the cells I have named be sufficient to work it? My zincs expose a surface of about 10 or 11 sq. in. each. I have read the articles in Nos. [illegible] and 811, but they do not furnish the information I want. I have been successful in depositing silver and copper; but nickel is quite new to me; so perhaps some experienced reader will kindly help me out of a—DIFFICULTY.

[51558.]—**To Mr. Wetherfield.**—(1) A.'s horse came into my field of growing corn and did damage to the extent of £4, according to the valuation of a licensed valuer. A. says his horse came through my hedge (i.e., at a place where the ditch was on A.'s side), and says on that account he is not liable. Is this so? Is he not bound to see that his stock shall not injure his neighbour's crops? I deny his statement as to place of entry, and have claimed the amount of damage in writing; but also wish to know if, in taking the case to the County Court, I should also state the valuer's charge as part of the debt? Or must that be left to the judge to include it in "costs"? (2) Can you recommend a work on the law as relating to the duties, responsibilities, privileges, &c., of land occupiers, tenants, owners, &c., as to hedges and fences?—H. L. R. H.

[51559.]—**Tonnage of Steamers.**—Will some one kindly explain the difference between awning-decked and spar-decked steamers?—LONDON RIVER.

[51560.]—**The Atomic Theory.**—According to the atomic theory the elementary units of mass are in all respects equal, are absolutely hard and inelastic, absolutely inert, and therefore purely passive. But, according to the atomic theory of chemists, some atoms are much heavier than others; and in fact the chemical theory will not work with the mechanical. How is this? Which is the correct atomic theory?—NEMO.

[51561.]—**To Mr. Wetherfield.**—I advertised some shares in Starr-Bowkett Society, £30 paid in, for £23. A gentleman wrote and told me to call with the books. After seeing them he agreed to buy them, less 12s. (there only being £29 8s. paid), and paid 10s. deposit, and I left the books with him. He now refuses to buy them on the ground that he will have to pay £2 working expenses on withdrawal, although the rules were in the book to that effect when he saw them. Having lost the opportunity of selling them now, can I compel him to complete the purchase, and what steps ought I to take?—H. KNOWLES.

[51562.]—**Burnishing and Setting Razors.**—Will some reader inform me how razors are burnished and how to set same to the finest edge? If possible, I should like to know the method used in their manufacture.—[illegible]

[51563.]—**Shaft.**—Will some one please tell me if my shaft is strong enough to carry 12 arms, each having [illegible] at ends and 16ft. long from centre of shaft, fitted [illegible] from top. Shaft is a 14ft. length of steam tube, 2in. inside, 2½in. outside, to stand in a vertical position with bearings at about 2ft. 3in. from ends, and [illegible] 12 revolutions per min. If not, what will do?—THOMAS.

[51564.]—**Microscopic.**—In a microscope by one of the best makers the 100th part of an inch in the stage micrometer with a $\frac{4}{10}$ object-glass corresponds to 7½ [illegible] of an inch in the eyepiece micrometer in B eyepiece. 7½ [illegible] is equal to $\frac{15}{80} = \frac{3}{16}$; and $\frac{3}{16}$ of an in. is the same thing as 18¾ hundredths. That is to say, a $\frac{4}{10}$ [illegible] glass in a first-class microscope only magnifies with the second eyepiece 18¾ diameters. How am I [illegible], and how can I accurately tell the number of diameters any given object-glass and eyepiece magnify, including eyepieces not used for the micrometer?—L. B. B.

[51565.]—**Photographic Printing.**—To MR. [illegible]—Will you kindly tell me where I am working amiss? My prints are a beautiful plum colour before going into the hypo. bath, to the point, but they lose it all after having been in the latter bath.—I want to keep a stock solution of saturated hypo. How many ounces of this ought to be added to the pint of water for fixing prints?—As alum is said to assist in eliminating hypo. from negatives; would it do for prints, water being a [illegible] consideration?—R. D. H. B.

[51566.]—**Odourless Waterproofing.**—Can any reader kindly give me a recipe for making either cloth, [illegible] or [illegible] waterproof? The preparation needed is one that will withstand immersion in beer when barrelled without imparting taste or smell to the beer. Would a mixture of gelatine answer the purpose, and if so, how long would such a coating stand waterproof when immersed in the barrel filled with beer? Any recipe likely to be of service will be much valued.—H. F. [illegible]

[51567.]—**Tenant's Liability.**—To "LEX."—To what extent is B. liable for dilapidations under following circumstances?—A takes a house on three years' lease. After the three years he keeps on as yearly tenant for nearly two years, and then quits in favour of B. by landlord's sanction. B. holds the house for several years without any fresh lease. On leaving the house, is he liable for damage done by A. while a tenant, and is he bound to repair according to terms of A.'s three years' lease?—X. Y. Z.

[51568.]—**The Audiphone.**—My hearing is considerably impaired through the thickening of the eustachian tube, or throat deafness. Can anyone tell me if the audiphone is practically of use in this case for conversation, hearing lectures, &c. An ear-trumpet maker told me it was not; but he might not be unbiased. Before trying one of these rather costly appliances, I should feel greatly obliged for any information about them, which might also be a boon to others besides myself.—A. E. C.

[51569.]—**Legal.**—If a son of a widow goes wrong, and leaves his wife and children chargeable to the parish, is the widow compelled to maintain them? There is property coming to the son at the widow's death.—S. CRANE.

[51570.]—**Blacking Machinery.**—Will any reader inform me what sort of machinery is required for blacking making? Also, if there is any machine for making small quantities, and where obtainable?—T. E. TAYLOR.

[51571.]—**Steam Punt.**—I am anxious to build a steam punt for use on a small narrow river where weeds are very numerous. For this reason I have decided on a single wheel astern as in the American up-river boats. Any hints as to the best way to build the boat—size, pattern, and power of engines, boiler, &c., with sketches, will be esteemed a great favour by—E. P.

[51572.]—**Oxide of Copper Battery.**—To "SIGMA."—Please say if this cell is suitable for working incandescent lamps. If so, what size of cells would you recommend, and will the common black commercial oxide answer, which is sold at about 2s. per lb.?—C. TURNER.

[51573.]—**Filling up Crests, &c., on Plated Articles.**—I have just bought a quantity of plated articles, all having crest and initials engraved. Is there any method of filling up?—DEALER.

[51574.]—**The "English Mechanic" and Time.**—The first volume of the ENGLISH MECHANIC ended on Sept. 22, 1865. The XXXVIIth was completed on the last day of August, 1883. When will the volume be completed in June?—NUN. DOR.

[51575.]—**The Passion Flower.**—Can any of your readers tell me if it is possible to bloom this plant in a pot, and if so, how old must it be? Is it advisable to stop it severely?—S. R.

[51576.]—**G.E.R. Engines.**—Can any reader give some account of the six-coupled goods with a small wheel in front (presumably a bogie) of this line? I have seen one or two at March and on the Cambridge main line.—BUFF.

[51577.]—**Rushton's Self-Acting Fountain.**—Will some reader tell how I can make one of the above fountains? It is started by blowing for about a minute. A sketch will greatly oblige.—CHEMICUS.

[51578.]—**Rhinoceros Horn.**—Having broken about 6in. off the end of a walking stick made of this material, I shall be obliged by practical information how to proceed to draw it out to its original length, and how to repolish?—C. F. A.

[51579.]—**Drilling Emery-Wheel.**—[illegible] reader inform me how I can drill [illegible] emery wheel 1¼in. thick?—S. J. R.

|—**Model Boat.**—I have a model boat 5ft. should like to make an electric engine to drive I would be able to make myself, but do not ctly what pattern to make it. Would any of me out of my difficulty? The engine to work -WAUN.

|—**Windmill.** — Living in a very exposed .should like to know it I constructed a wind- ld it do to drive a dynamo-electric engine for ght purposes? If so, what pattern would it made?—WAUN.

]—**Violoncello Strings.**—What is the cor- h of strings of a violoncello from the nut to the E. H.

—**Cement for Aquarium.**—Can any of ne what will stop an aquarium from leaking? alt water, so there must be nothing in the hich would be acted on by the water. Every- mmends a cement made of white-lead and red- d together into a paste. I don't believe in it. re good reasons for not doing so, since the has been mended four times in succession with g fresh stuff each time, and it runs out now as t did as first. Each time the water has run out g one night in the aquarium. I am afraid if n recommend another cement, I shall have to e glue, and I don't want to do that because of ionable smell, as I said once before in last vol. say that the aquarium is 1ft. high, and holds of water, so that the pressure is very consider- any one can tell me of a cement warranted to pressure, and not composed of white and red all be very grateful. It is no use referring to bers, for I haven't got any, except this year's. swer as soon as possible, as it is very awkward ow where to put the anemones, &c., which were arium.—R. A. R. BENNETT.

|—**H.P. of Engine.**—Will some kind reader he h.p. of a six-wheeled coupled locomotive aving 5ft. 1in. wheels, 18in. cylinders, 26in. essure of steam in boiler 140lb. to the sq. in.? se of baffle plate in firebox?—EXON.

|—**Water-Motor for Blowpipe Fan.**—I greatly obliged if any reader could inform me nstruct a water motor (model) to work small blowpipe.—W. MORGAN.

|—**Windmill for Pumping Water.**— e one kindly oblige with a few hints as to the ion of a simple windmill suitable for raising the supply of a large house, and the best way of the power to the pumps?—KERAULOPHON.

|—**Preparing Millboard, &c., for Oil g.**—Can any one tell me how to prepare mill- rtridge paper, or canvas for oil painting—the the preparations, or any books on the subject? ATEUR.

—**Nervousness.**—Can any of your scientific rs offer a remedy to one suffering as follows?— months ago I rode a long bicycle race, which l and excited me considerably. Next day I felt upid, with retching and a touch of dysentery. 28 days I got quite melancholy—hating all en music): would rather not look at the light sun; a continual noise like frying of meat in ; a shortness of breath, an excited feeling, rest- &c. After some time I found a little more ut I am still suffering from a bad memory and nergy. I was a strong thinker in time past, and l of excelling in every engagement—whether r mental. I feel my condition like a millstone around my neck. I feel as if there is some in- the usual pulse in my temples, and my skin is ot, especially my head. I have consulted some s, who told me it would wear away. I am not a or smoker; age 26—married some months. the best course to take? My appetite has been l all the time.—A. McC.

]—**Water Colours.**—Would some one inform method of keeping water-colours moist after them myself, and how to mix them in the to make them adhere and work nicely? I am of the ordinary dry colour that you buy at so r lb.—H. M. F.

]—**Electrical.** —To MR. LANCASTER OR —(1) Having a tangent galvanometer, I should now how to calculate current in ampères by it. It has (*a*) two turns of thick wire, and (*b*) s (ten turns each, making twenty) of fine wire. m. of wire 6·75in. Please give earth's intensity ear as used in this answer. (2) Does any type telegraph use a single wire for transmission of (3) If mercury be added to melted zinc for attery rods, is not the heat sufficient to vaporise therwise, is this method as satisfactory as surface amalgamation?—CARBON, London.

]—**Cigarette Machine.**—Will any corre- kindly tell me how to make a little machine for igarettes, as I find it rather difficult to make them ?—G. FRYER.

]—**Utilising Vegetable Fibre.**—Will any ndly describe machines for extracting the fibre Agave, Bromelia, and other leaves?—NICARA-

]—**Portuguese Grammar and Diction-** an any one recommend a really good Portuguese , and also an exhaustive dictionary?—LINGUA.

]—**Crystoleum Printing.**—Would "R.B." her reader give a few hints concerning the mix- ints, so as to produce the different colours re- crystoleum painting? Also is the preservative ng crystoleum permanent, and medium, one and thing, as a tube of medium cannot be bought— les of preservative medium?—M. WILSON.

]—**Chinese White.**—Of what is this substance , and how is it prepared? What solvent should o keep it moist or to moisten it when dry? I most impossible to get rid of grittiness with SALVO JUKE.

]—**Platinum.**—Will some kind subscriber (a tell me the names of the substances, acid and alkaline, that act on platinum? That is, what substances corrode it? Will caustic potash solution or chlorine act injuriously on it? Kindly state all known substances that act injuriously on it?—HOROLOGICAL.

[51597.]—**Oxide of Copper.**—Could some kind subscriber tell me of a cheap method of making oxide of copper? I am aware that by heating sheet copper red hot and plunging into cold water a film of oxide forms on it, but is there not a cheap method of making it from the sulphate or any other simple way?—HOROLOGICAL.

[51598.]—**Platinum in Battery.**—Would our kind contributor "Sigma," tell me with what solutions I may safely use platinum as a negative in a battery, &c.? Can it be used in sulphate mercury battery, caustic potash battery solutions, caustic soda solutions, and any of the chlorides and chlorine? Would it be safe to leave platinum in mercury for any length of time?—H. W. H.

[51599.]—**Haulage.**—(1) What would mineral cost per ton per mile drawing on ordinary tram rails by men or boys, when men's wages are 4s. per day? (2) What would it cost by horse when horses' keep and drivers' wages amount to 6s. per day? (3) What would it cost on edge rails? A rule for the above will oblige.—SCOTTIE.

[51600.]—**Chemical.**—For purposes of photography I keep ready dissolved 10gr. each of citric acid and potassium bromide in 20oz. of water. In the course of a week after it is made up, there appears in it a pure white fungus-like mass. What is this? Will these salts not keep in solution?—VOLVOX.

[51601.]—**Photographic.**—Can any reader name a book on the theory of photography? That is, explaining what are supposed to be the chemical reactions in dry-plate films. I have Abney's "Instruction in Photography,' but would like another.—VOLVOX.

[51602.]—**Testing a Piano.**—I should feel obliged for information concerning the different parts to notice when buying a piano.—G. O.

[51603.]—**Corliss Valve Gear.**—Will "Glatton" or any other gentleman be kind enough to embalm in ours a graphic method of observing the action of the above gear? All books on valve gear with which I am acquainted give this gear, considering the extent to which it is used, a very cursory and unsatisfactory notice. Could the well-known Zeuner diagram, as used for ordinary slide valves, be modified so as to render it applicable to the Corliss?—ECCLESTON.

[51604.]—**To "Sigma."**—In a back number you allude to the superiority of a certain French steel for magnets. Could you inform me where the works are that produce it? I know a firm that would try and make some in England, if a sample could be had of this peculiar French steel.—MAGNETO.

[51605.]—**Water Power.**—I am putting down a breast waterwheel, 7ft. diam. The water strikes the wheel one foot nine inches from the top. How much water per minute must pass through to gain one horse power?—FARMER.

[51606.]—**Repairing Engine.**—I am about to repair a 25-horse horizontal steam-engine which at present will scarcely drive three ordinary circular saws. Now what I want to do is to increase the power as much as possible. I may also add there are two valves, main and expansion, but owing to the small amount of power, the driver has taken the expansion valve off and worked the engine with the main valve cutting steam off at ½ stroke. Now what I thought of doing was to take a slight chipping off the valve face and turn the eccentric round so as to cut steam off at ¾ stroke. Of course, in this case more steam will be required. Will anyone kindly tell me of any other way without increasing pressure in boiler, which is at present 60lb.? Main steam valve faces and throttle valve in good order, and engine quite free from all binding. I may also state the driver says the engine has never given anything like its proper power ever since it was fixed. Any answers would greatly oblige.—YOUNG FITTER.

[51607.]—**Dissolving Human Hair.**—I have read in a back number that hair can be dissolved by boiling in a solution of caustic soda. If this is correct, could any one tell me how I could withdraw the caustic soda, leaving all the constituent parts of the hair in a state of solution? Or, by what other means could I obtain the same result?—NO CHEMIST.

[51608.]—**Patterns for Boots and Shoes.**—I want to understand the art of cutting patterns for boot and shoe uppers. Is there a book published on the subject? The information given by "Jack of All Trades" some time ago is too meagre for my purpose. I cut my patterns on a last, but do not know how the height at back and side and length of vamp is regulated. Will any one tell me? To amateurs, as fathers of families with small means, as well as myself, this information, I think, would be very valuable.—POLITZER.

[51609.]—**To Mr. Wetherfield.**—There is a clause in the New Bankruptcy Act which provides that a tenant's property to a certain amount is protected from seizure by landlord. Does this apply to matters of rent, or only to cases of bankruptcy or liquidation?—POLITZER.

[51610.]—**G.E.R. Locos.**—Will some one give particulars of a train engine (No. 131) which I understand is being turned out at Stratford? Also are there any more of the new coupled expresses coming out—562 class? What are the cylinders and wheels of Nos. 556, 616?—H. S. P.

[51611.]—**Levelling.**—Could any correspondent give me some advice as to the best kind of level for rough use in foreign countries? Is a "Dumpy" or a "Y" preferable? Also, what is an Abney's level, and a builder's level? Any information will oblige.—E. E. R. T.

[51612.]—**Tunnelling.** — Can any correspondent kindly give me some information as to the method of keeping the levels and lines of a tunnel, which is being driven from both ends, so as to insure the work meeting correctly? I shall be glad of any information on this subject. Can anyone also recommend me a cheap and reliable book on tunnelling? How is the area of the section of a tunnel having curved top and sides calculated?—E. E. R. T.

[51613.]—**Knapp's Solution.**—A description of the mode of preparing the above solution, and the method employed when using it for the titration of grape sugar, will oblige.—N. C. B.

[51614.]—**Sliding Door.**—I have a sliding door to my workshop which it is requisite should be kept shut. Can any of our numerous readers inform me of an appliance that will shut the door when left open—something that will not make it much harder to open? I may add that the door runs on pulleys at the top.—W. LISTER.

[51615.]—**Brass and White Ornaments.**—How are brass or white metal cast figured ornaments finished in Sheffield, Birmingham, or elsewhere?—W. WILSON.

[51616.]—**Hosiery Goods.**—In buying hosiery goods (lambswool shirts, pants, &c.), the seller tells me the quality is 10, 12, or whatever the gauge may be. Kindly explain what is meant by gauge and how to tell the different gauges? I find each article marked with small holes (as if the stitches were left out), thus ⁚; those of a finer quality having more holes. Can you tell the gauge by these holes, and if so, how do you count? Or do different makers use different marks or holes for the same gauge?—D. M. L.

[51617.]—**White Metal.**—Will one of ours kindly inform me how to mix white metal, such as cheap brooches are made of?—J. SMITH.

[51618.]—**To Mr. P. J. Davies.**—Will you be so kind as to show me in plain figures how the following is worked out? We have the town's water in the mill. The mill is 63ft. high; the pipes are ½in. Suppose there is 100lb. pressure at the bottom, what will there be at the top? Also, will you give me instructions how to make a counter as you showed attached to the pump a few weeks back to count 126,000?—YOUNG ENGINEMAN.

[51619.]—**Specific Gravity.**—Will any kind reader inform me how to calculate, from the sp. gr. of any solution, the amount of solid matter which is contained in, say, a gallon of distilled water, and also give me a rule by which I shall be enabled to reduce a liquid from one sp. gr. to another by the addition of distilled water?—SPECIFIC GRAVITY.

[51620.]—**Photographic.**—Will any reader inform me whether the photographic business is a profitable one or not in Tasmania—if dry plates and the necessary chemicals can be obtained at about the same price in Tasmania (Launceston) or Melbourne as they are in England, or would it be advisable to take out a stock of materials?—A WOULD-BE PHOTOGRAPHER.

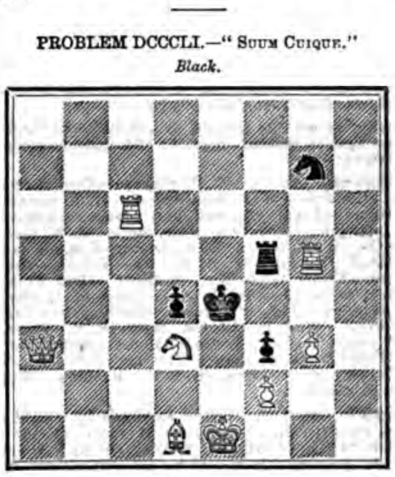
[51621.]—**Glue.**—Please inform me how to make glue acid and waterproof.—J. GRANT.

CHESS.

ALL **Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.**

PROBLEM DCCCLI.—"SUUM CUIQUE."

Black.



White. [8+5

White to play and mate in two moves.

SOLUTION TO 849.

White.	*Black.*
1. B-Q 7	1. Anything
2. Q, B, Kt or P mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 848 by Dicky Sam, F. V. P., and H. Jacobs; to 849 by J. Keylbee-Hewson, E. Stanley Follwell, F. V. P., Dicky Sam, C. Planck.

J. H. B.—Game received with thanks.

F. F. B.—Thanks for slip.

H. JACOBS.—Sorry you are not able to continue.

THE *Matlock Register* is about to start a two-move problem tourney. Those anxious to join it can obtain particulars by communicating with the Chess Editor, Mountain View, Clontarf, Dublin.

Holloway's Pills will render to delicate invalids the most essential service when they suffer from bilious affections, loss of appetite, or indigestion, through damp or variable weather. Lowness of spirits, sick headache, dimness of sight, faintness, and vertigo resign their perplexing sway after a few doses of this regulating medicine.—[ADVT.]

no one can object to a patent on the ground that it comprises more than one invention. The exact force of this section can be known only when it has been determined by the Court, but no exception can be taken to it if it means, in the case of a machine, the invention as a whole, and certain parts which might otherwise be the subject of separate patents. Provision is made for the granting of a patent to the legal representative of a deceased inventor, if application is made within six months after his death. Section 40 provides for the issue of an illustrated journal of patented inventions containing reports of patent cases decided by courts of law, and such other information as the Comptroller may think useful or important. Section 45 is very important, and is that referred to at the commencement of this article; for as phrased it appears that applications left at the office between now and Dec. 31 will pay the diminished fees, and escape the examination and the liability to grant licenses. Thus the provisions of the Act relating to applications and proceedings thereon shall have effect only in applications made after the commencement of the Act. Every patent granted before the commencement of the Act, or on an application then pending, shall remain unaffected by the provisions of the Act relating to patents binding the Crown and to compulsory licenses. "In all other respects (including the amount and time of payment of fees) this Act shall extend to all patents granted before the commencement of this Act, or on applications then pending, in substitution for such enactments as would have applied thereto if this Act had not been passed." We quote that subsection literally, for if it really means what it says, there will be a decided advantage in getting applications filed before the end of the year. By Section [illegible] the Comptroller is empowered, on request in writing accompanied by the fee, to correct clerical errors, &c., and by Section [illegible] it is provided that any application, notice, or other document may be sent by post, and shall be deemed to have been left, made, or given, at the time when in the ordinary course the letter would be delivered. It will be sufficient to prove that the letter was properly addressed and put into the post. Another section, [illegible] contains the important proviso that where any discretionary power is given to the Comptroller, he shall not exercise it adversely to the applicant without giving him an opportunity of being heard personally or by his agent. Extensive powers are given to the Board of Trade to make such general rules and regulations as may be considered expedient, and on these will depend much of the success of the Act in settling the vexed question of Patent Law reform.

EASY LESSONS IN BLOWPIPE ANALYSIS AND PYROLOGICAL MINERALOGY.—XII. (AND LAST).

By Lieut.-Col. W. A. Ross, F.G.S. (late R.A.)

Rationale of Outer and Inner Ball Formation. Sodium and Non-Sodium Yellow Flames. Cause of the Colour of Sapphire, Emerald, Amethyst, &c.

C.—"Before proceeding, Professor, would you kindly say if it is *necessary* to [illegible] calcium-borate ball before [illegible] B.B. to the boric acid, in order to [illegible] inner balls?"

"Certainly not. You can apply the [illegible] ball (XXXVII., 590), just [illegible] bead, B.B., and almost [illegible] the inner balls."

C.—"When I return shortly to America I [illegible] to correct and contradict the reports spread there by your [illegible] friends in England and elsewhere [illegible] of your system of analysis, and shall further maintain that I have the best possible evidence (that of my own eyes) for stating that *silica* is not the simple combination of two elements which it is universally supposed to be at present. But how do you explain the formation of these "inner balls" communicated to calcium pyroborate by silica; and, indeed, that of the *outer* balls also: a fact discovered by you apparently in 1869 (*fifteen years ago!*) but not yet taken into consideration by men of science, as I think it might have been?"

"I feel that in you, Professor C., I shall have my first *real* friend,—a man not only capable (for many are that), but having the sincere *wish*, and the influence or power, to defend or elucidate my simple exposition of THE TRUTH in philosophical analysis. The small sphericles or balls formed within a bead, by the application B.B. of lime and about 12 other oxides, to boric acid, are evidently due to the respective *cohesion of two liquids*—liquid, of course, only when in a state of fusion B.B.—which do not dissolve each other (although that is not the opinion of Professors Roscoe and Schorlemmer), but possess nearly the same specific gravity; just as this oil, poured into diluted alcohol, remains suspended within it in the forms of perfectly spherical masses. The two liquids in the case of lime applied B.B. to boric acid, are the latter (containing), and calcium borate (contained). The boric acid coheres to as near a sphere (see Lesson IX., para. 10, page 433, 'E.M.'), as the platinum-wire ring to which it clings will allow, and hence the advisability of making the ring as nearly round as possible. The calcium borate coheres to as many perfect sphericles inside the bead as there are fragments of lime applied; and these sphericles are immediately resolved into one by O.P. applied to the containing bead. It is usually supposed that the two liquids, in an experiment with fluids, *must* be of '*precisely* the same specific gravity.' ('Miller's Chemical Physics,' page 65), but that is not *necessary*; for, you see, here is a sphericle of pure gold floating in the boric acid bead B.B. in exactly the same manner as the calcium borate sphericles float."

C.—"This is quite clear; and, as you have shown the contained spheroidal borates to consist of materials in *definite proportion* to each other—exceedingly interesting and important to my mind; but I do not yet see why or how *calcium silicate* forms inner balls in *calcium* borate B.B. Why does not the lime of the of the former combine with or rather join the lime of the latter, and dissolve the silica transparently in the ball, as you showed us it did when the ball was held *per se* on a platinum-wire hook B.B.?' (Lesson XI., page 590, "E.M."). "Your observation shows that you are following me closely, and this is precisely the difficulty as regards the *nature* of these inner balls, which occurred to myself. In the absence of a menstruum (at present) for dissolving the outer, and thus obtaining for examination the inner balls *per se*, which will no doubt one day be found. (Prof. G. G. Stokes, Sec. Royal Society, recommends me to try *aceticacid*, which I intend doing.) I attempted tocome to some definite conclusion regarding them by a simple process of ratiocination, and argued thus: "If" (said I to myself) "these inner balls are silico-borate of calcium, balls will be formed, when pure silica is applied to the calcium borate, held *by itself* on a platinum wire, without the containing bead of boric acid B.B.; and this we have seen (Lesson XI., page 590, 'E.M.') is *not* the case. If, on the contrary, fresh boric acid derived from the outer containing bead is *absolutely necessary* for their formation, the presumption must be that calcium borate cannot be decomposed either by separate or dissolved silica in boric acid B.B.; or, in other words, that the calcium borate will not give up any part of its proportion of boric acid to the calcium silicate in order to form inner balls, or any part of its lime to combine with the silica; and that the originally added silica, therefore, is simply dissolved in the ball *per se*, and changed in its nature through the abstraction of its 'chemical water' by the action of calcium borate at this high temperature upon it. (Lesson XI., page 590, "E. M.") The silica then gradually becomes, as it loses this water, in a manner, *itself* 'caustic,' and capable of forming, at high temperature, a fusible compound with boric acid, which compound follows the law of cohesion of liquids while fluid and undissolved in the calcium borate; just as you see this speck of hard marble, when applied B.B. to a boric acid bead, at first appears (like silica) as an unacted-upon white opaque fragment; but shortly losing its CO_2 and 'chemical water' (which latter *immediately shows itself as grey opalescence* in the bead), it forms a fusible compound, and appears as a transparent ball of calcium borate, instead of a white opaque fragment of calcium carbonate in the bead."

C.—"Hullo! Professor, do you mean to say you think you have, in the formation of these inner balls, formed a new substance, hitherto unknown to chemists—i.e., *Silicon borate?*" "Most certainly. If you do not conclude it to be that from the full consideration of these experiments and results, will you kindly afford a clue to *any other* explanation of the phenomena? I consider that not only one new substance (silicon borate) has been here proved to exist, but that another substance (pure silica, or 'rock crystal,')—although not 'new' to chemists in one sense, has been hitherto entirely misunderstood by them as to its nature (it being in reality a *hydrate*), in consequence of their solely employing, in its analysis, *hydrated* acids." C.—"What do you mean by that last expression?" "I will make you explain it to yourself. You have seen, beyond all doubt, that what I have termed 'chemical water' causes the evolution of grey opalescent matter in boric acid B.B.?" C.—"Certainly, I am quite assured of that fact." "Well, now, will you be so good as to fuse a bead of this pure boric acid upon this ring of new, clean platinum wire? Good! You observe that, when cool, it is as transparent, colourless, and refractive as the 'rock crystal' of your spectacles itself. Now, dip that bead, in a state of red-heat, into this beaker of distilled water, and heat the bead again B.B. What do you observe in it?" C.—"Nothing; the bead is lessened in bulk, in consequence of the bursting of the innumerable bubbles of steam formed, but it is now as transparent and refractive as before." "Now, mark! I pour just a little sulphuric, or nitric, or hydrochloric acid into the beaker of distilled water, and stir it well round with this perfectly clean glass rod. Be so good as to dip your red-hot bead again into this acidulated water, and, after heating B.B., and cooling, tell me the result?" C.—"The result is, faint streaks of grey, opalescent matter, which, on further heating and cooling, *render the whole bead slightly opaline*, and I see now what you mean by the expression 'hydrated acids.' It seems to me, therefore (adopting your views, which I don't say I wholly do yet), that if we treat calcium borate (or the anhydrous contained ball) *separately* with silica in a boric-acid bead B.B., the combined lime, *only during the continuance of high temperature*, has an attraction for the supposed "water" of the silica, and extracts it; itself becoming *hydro-borate* of calcium *only during the period of high temperature*, giving up the thus-obtained 'chemical water' on cooling, to the surrounding boric-acid bead, where it (the chemical water) floats undissolved as a finely-divided precipitate on becoming cold (for I see the whole bead is perfectly transparent whilst hot) which you call 'grey opalescent matter,' but which I should certainly call '*Hydrated boric acid*' ——" "My dear sir,"—"Stop a bit; I haven't done yet. If we admit all this, it seems to me to follow that, if you dissolve 'hydrated' (or ordinary) silica in calcium borate held *per se* on a platinum hook ('E.M.,' p. 590) and then treat the siliceous ball in a boric acid bead B.B., the lime of the ball, caustic in spite of its combination with boric acid *at high temperature*, and *then only* capable of forming the double combination with this water and boric acid which I will call 'Calcium hydroborate' (only existing at high temperatures) extracts the water, as in the other case, from the silica; although in *this* case, the silica being contained within the ball cannot escape into the *bead*, but there—i.e., within the ball, forms the fusible compound with boric acid obtained through the ball from the outer bead of which you speak: which, assuming the spherical shape whilst fused and liquid, in obedience to the law of cohesion, appears, finally, as 'inner balls of silicon borate'; when, of course, the containing ball would be much heavier, in spite of the opaline matter it evolved. Is this what you mean?" "My dear sir, you have expressed my meaning more clearly than I could myself." C.—"Well now, will you kindly explain, if your conclusion is correct, how it is that the silica, dehydrated (and thus rendered capable, according to your account, of forming 'silicon borate') by the calcium borate ball treated *separately* with it B.B. in a boric-acid bead, does *not* then form 'silicon borate' *separately* in the *bead*?"

"For two reasons: 1st, because the boric acid, with which the inner anhydrous silica combines, is derived from the containing ball, where it must be *absolutely anhydrous*; the ball meanwhile supplying its loss, with boric acid from the containing *bead* in exchange for the water derived from the silica; so that *a round of chemical exchange* goes on. 2nd. Because perhaps the two fused fluids, 'silicon borate' and calcium borate, are suitable for exhibiting the phenomenon of floating spheres (as oil and dilute alcohol are suitable); and the two fused fluids, 'silicon borate' and boric acid are *not* suitable (as alcohol and water are not suitable)."

C.—"Well, there is no doubt the inner balls *do* exist (and must be accounted for somehow), for I have just broken a calcium borate ball containing them in half, and placed it under the microscope; and here they are sticking out of the broken side of the hemisphere. Is silica the only substance which, thus applied, forms inner balls in calcium borate?" "Oh, dear, no: zirconia, glucina, alumina, tungstic and molybdic acid; in fact, so far as I yet know, *all 'earths' and non-volatile oxides, which do not themselves form balls in boric acid* B.B., form these inner balls. The sublimate of *antimony* forms balls in calcium borate *per se* B.B. with the evolution of 'chemical water.' But the inner balls formed by some oxides, as tungstic acid, *crystallise under continued O.P.*, and these crystals *constantly exhibit the same form;* which, as you know, is quite the contrary with borax crystals B.B." C.—"Again, this seems to me a matter of *extreme* importance." "You stated just now that I ought to call that fine precipitate, which appears as grey opalescence in the clear B. acid bead, *hydrated boric acid.* Would you suppose now that boric acid thus 'hydrated' should have changed any of its properties?" C. — "Certainly I would; and, indeed, I was just going to remark that your boric-acid beads, opaque with grey opalescent matter, seem to differ in no respect (except opalescence) from the transparent beads." "What substance, then, would you call this?" (*taking some white powder out of a bottle, and heating it on a platinum spatula under C.'s nose*), C.—"Resin; or some related hydrocarbon." "This, sir" (*fusing the powder B.B. on a pt. wire ring*), "as you see, is opaque, or *hydrated boric acid*, which apparently acquired that peculiar smell of resin by simple exposure to the air, in about a year after it was hydrated in the Royal Artillery Institution Laboratory, Woolwich, in 1873." C. (*reflectively*)—"Are you *quite certain* of this? The resinous smell on ignition is unmistakable; and yet there was certainly no inflammation, as would be the case in thus heating resin. Was this boric acid hydrated with 'water' from silica?" "No, but you see, it also rehydrates calcined lime." (*Calcining to white heat in O.P. of the hot-gas lamp a fragment of pure marble, larger than the opaque bead, upon the latter. The glowing lime slowly clarifies the bead, and, when afterwards separated from the bead, crushed, and applied to fresh pure B. acid B.B., evolves grey opalescent matter into the transparent bead*). "Follow me in this experiment, and I will now show you how this B. acid was hydrated. When I thus make a paste of *calcium hydrate* (590, XXXVII. 'E. M.'), and dry it as a large white opaque bead in gentle P.P. on this pt. wire ring (Fig. 16, p. 255, 'E. M.'), bend the long wire double, and fuse a bead of pure boric acid upon a similar ring made at the other end of the wire, holding the two beads at the bend of the wire in the forceps (Fig. 17), so that the 'flame' of the hot-gas lamp, directed upon the Ca hydrate, plays *afterwards* upon the B. acid; what is it that causes this gradual opalescence in the transparent, colourless boric acid?" C.—"Why, the 'chemical water' of the calcium hydrate; I quite understand that now; there is really no necessity to go through all this *again*." "Excuse me, sir, that is not my object; but do you observe this yellow flame emitted from the calcium hydrate whilst it is slowly calcining in O.P., and evidently *causing* the opalescence in the boric acid, by impinging steadily upon the bead, until the hydrate is perfectly calcined and begins to glow white-hot?" "What is that?" C.—"What is that yellow flame? Why, *sodium*, of course!" "Observe me now, and I will prove to you that it is *not* sodium. Taking the lime-bead off the first ring, I substitute for it a bead of sodium carbonate, and thus, allowing *its indubitable* yellow sodium flame to impinge upon the bead of opalescent boric acid; what is the result?" C.—"*The opalescence removed*, by Jove! The same cause producing opposite effects. A *reductio ad absurdum*. Against Euclid. No, this won't do at all. I admit, sir, that the *first* yellow flame *cannot possibly* be due to *sodium*." "To what, then, do you suppose it to be due?" C. (*considering*)—"Well, the yellow flame, which rendered the boric acid opalescent, certainly ceased *as soon as* the calcium hydrate was calcined, leaving anhydrous lime behind; this hydrate I have seen to similarly opalesce boric acid, leaving (as was proved by the assay balance) anhydrous calcium borate behind.—Sir, I see no other conclusion except that the *first* yellow flame is caused by the *ignition* of this 'chemical water,' as you call it." "That has been my conviction for twelve years; but you are the first man of science I could get to listen, patiently and intelligently, to my proofs. Some declared they could not understand such simple evidence. *All* (very unphilosophically, I think), laughed at me and my proofs; and said I was setting the Thames on fire, &c., &c. But I will now show you how I hydrated this boric acid with the resinous smell on ignition. Taking the bent platinum wire again, I insert in the ring next the O.P. this little roll of new clean platinum foil, simply to have a considerable quantity, or *bulk*, of platinum in contact with the blowpipe 'flame,' as it then cannot be heated beyond redness, and will consequently, *continuously* emit a yellow flame; *this* yellow flame also, as you see, renders this fresh bead of pure boric acid opalescent.

Well, before I discovered this fact, I fused about an ounce of pure, crystallised boric acid in a clean open platinum dish at a table-blowpipe in the R.A. laboratory, Woolwich, with the result of finding all my boric acid grey, opaque, and (as I thought) spoiled! I do not mean to assert that you cannot fuse boric acid in platinum *without* producing this result; but I overheated mine, keeping the platinum at a strong red heat for some two hours, and producing, therefore, an enormous amount of this *yellow flame*, which filled the dish, playing upon the boric acid all the time it was being fused. I don't remember it exhibiting this resinous smell on ignition at first, and imagine, therefore, that it was thus rendered capable of gradually absorbing more hydrogen (and, perhaps, carbon) from the air to which it was constantly exposed when the stopper of the bottle was left off. I will now show you another curious result of the supposed hydration of this boric acid. You see I have got here a stoppered bottle of grey mineral powder. It is pure crystallised *Wavellite*, lately discovered in the country of which you are so justly proud (THE STATES), but baked for a fortnight in my kitchen oven (which you now know better than to suppose would eliminate the "chemical water," and which it in fact *concentrates*), crushed, and put into this bottle. I purchased this *Wavellite* some years ago, from Henson in the Strand, because I knew it, as aluminium *hydrated* phosphate, to contain a large amount of 'chemical water,' and was curious to see what the effect would be of dissolving its fine powder B.B. in my *hydrated* boric acid, by means of the cautious addition of potassium *hydrate*. You shall now do this yourself; but first I would ask you to test the *Wavellite* for iron or other possible metallic colouring oxide, with the borax you have there, as you do not believe in my reagents."

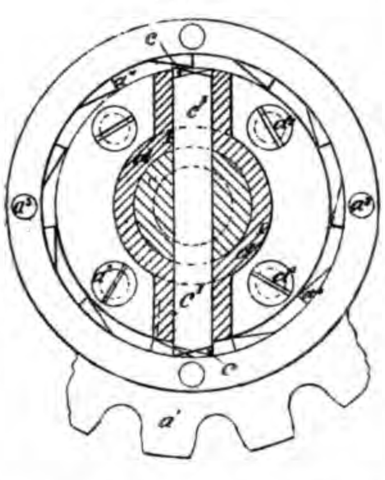
C.—"Do not say that, sir; I begin now to see the drift of what you call your system, and shall uphold it wherever I go; but I now try this powder, as you suggest, in borax B.B. for the satisfaction of others, and I find the borax bead not even yellow hot; so presume the powder to be so far free from metallic colouring oxides, that at all events, they cannot afford any recognisable colour to a bead. Now, what shall I do?" "Fuse some of the resin-smelling boric acid B.B., to a bead on this platinum wire ring, and, taking up on the hot bead gradually, some of this baked *Wavellite* powder, with a mere trace of potassium hydrate to dissolve it, treat the mass with a powerful H.P. (you know what that means now) from the 'hot-gas lamp.'" C.—"Good: the bead turns a bright purple." "Now, dip the hot bead, first in the hydrated boric acid again, and then in the *Wavellite* powder, *plus* a trace of potassium hydrate; and continue the treatment with H.P." C.—"This is really *surprising*. The bead is at first purple, then a beautiful sapphire-like *blue*, and quite transparent; then it becomes an equally brilliant emerald-like *green*!" "If you wish it to remain blue, dip it in the hydrated boric acid again." C.— "*Dark blue*, again! *All* these colours cannot possibly be due to any metallic oxide: cobalt would give a blue bead; copper or chromium a green one; and manganese a purple one; but no single oxide could produce *all three* colours. Did you not communicate this important matter to your Royal Society?" "Yes, and the Secretary sent me the materials back again, with a polite note to the effect that he had not time to try them as suggested, but power is communicated. Here, as in the previous method, it is possible by the addition of a reversed set of inclined planes and cavities to make this into a reversible clutch by a sliding arrangement which changes the balls from one circle of cavities to the other.

The chief advantages of this clutch will be found in its silence, wear, and above all in this, that, by properly adjusting the ball chambers, it can be made to give almost no backlash. It might be applied to the velocipede in the same way and in the same position as other clutches.

In a fourth method of double driving the patentee places one or more circular discs upon the treadle shaft and others to correspond upon the hub or shaft of the driving wheel or wheels, the motion being carried from the treadle shaft to the driving wheel by one or more spindles with rollers fixed on them at each end, the motion being communicated by friction. An arrangement for raising and lowering the said spindles makes a change of speed easy, and a system of this description attached to each driving wheel will give a very safe and certain method of steering the vehicle as the rider accelerates or checks the speed of either driving wheel, and in this case the third wheel of a tricycle would be made merely as a castor to carry part of the weight, not as a steering wheel, which is its usual purpose.

Fig. 1 is a front elevation, and Fig. 2 is an edge view partly in section of the first improved method of double driving. Fig. 3 is an edge view partly in section of the second method of double driving. Fig. 4 is an elevation of the outer ring with ratchet teeth, and Fig. 5 is an elevation, partly in section, through the line A B Fig. 3

FIG. 5.



In Figs. 1 and 2, *a* is the driving shaft to which is keyed or secured the bevel wheel a^1; loose upon the shaft *a* and facing the bevel wheel a^1 is a second bevel wheel *b* which forms part of the hub of one of the driving wheels. Four bevel pinions *c* are placed between and gear into both the bevel wheels a^1 and *b*. The bevel pinions *c* are fitted on studs c^1 upon which they are free to revolve: the studs c^1 are attached radially to an inner ring c^2 and are secured at the other end between the two flanges of an outer casing. This casing forms the chain wheel *d* and the brake wheel d^1, which are fastened together by the screws d^2. Motion communicated to the chain wheel *d* by the power of the rider or by any other agency will be transmitted through the bevel pinion *c* and the bevel wheels a^1 and *b* to both driving wheels.

In Figs. 3, 4 and 5, *a* is a metal disc with a boss by which it is mounted loosely up on the shaft *b* in which is cut the slot b^1. Two metal rings a^1 and a^2 are secured to the metal disc *a* by screws a^3. The ring a^1 forms the chain wheel, and the inner surfaces of the chain wheel a^1 and ring a^2 and cut in opposite directions are two rows of ratchet teeth a^4 and a^5, with an annular space a^6 between them. Two bars *c* and c^1 acting as pawls pass through the slot b^1 in the shaft *b* and are held in position by slots through two metal discs *d* and d^1 fastened together by set screws d^2: the pawls prevent the metal discs *d* and d^1 from revolving independently of the shaft *b*, but permit them to traverse the shaft to the extent of the slot b^1: the ends of these pawls *c* and c^1 are bevelled in opposite directions so as to gear with either set of ratchet teeth, and are of such length as to just miss the teeth on one side when in full gear on the opposite side, and when one pawl is in gear the other runs free in the annular space a^6: a clutch (not shown in the drawing) which takes into an annular groove d^3 in the boss of the disc *d* is employed to shift the pawls from one set of ratchet teeth to the other. By sliding the discs *d* and d^1 as far as possible in the direction of a^5 the pawl c^1 gears with the ratchet teeth a^5, and by sliding the discs as far as possible in the other direction the pawl *c* gears with the ratchet teeth a^4. If the annular space be made sufficiently wide, by placing the discs midway between a^4 and a^5 both the pawls are thrown out of gear and can revolve in the blank space a^6. The metal disc *a* and rings a^1 and a^2 may be made in one piece, and the discs *d* and d^1 may also be in one piece, if preferred. When motion is communicated from the shaft *b* to the pawls *c* and c^1 that pawl which is in gear with the ratchet teeth will transmit the motion through the chain wheel a^1 and drive the machine in one direction. By sliding the discs, the other pawl gears with the other row of ratchet teeth and drives the machine in the reverse direction.

PRACTICAL NOTES ON PLUMBING.—LXXX.*

By P. J. DAVIES, H.M.A.S.P., &c.

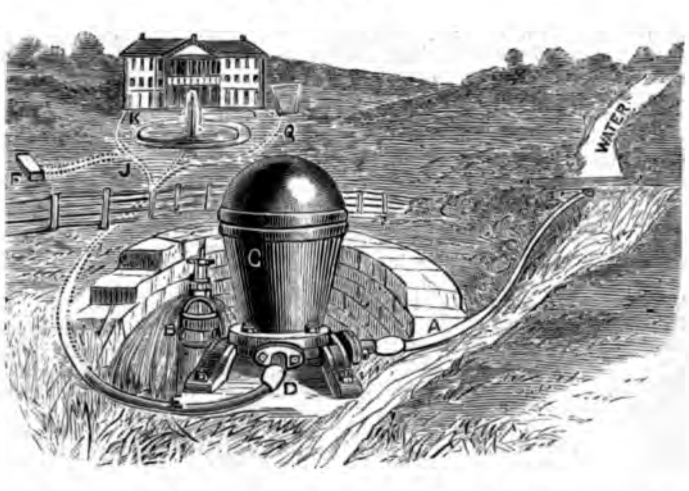
(*Continued from page* 5.)

Rams With Double Foot Valves.

ALTHOUGH I have written so much in favour of this machine, of course I do not mean to imply that we have no better, or, as far as water is concerned, no more economical machines for raising it, that is to say, *where only a limited quantity can be obtained*, or is necessary for the working of the machine itself, because if we come to that point, there is no machine equal to the overshot water-wheel, shown at Fig. 366 C, but what I wish to imply is this: that the ram is, of all water machines, the most simple, and will answer every purpose in places where large quantities of water may be had to run to waste.

The ram will work pretty well under an 18in. head of water; yet, like the water wheel, the greater the fall, and the better the supply of water applied, the more water can be thrown, and, of course, the more powerful will be the machine, though, be it understood, that it is quite possible to have too great a fall, and therefore the fall should be only in due proportion to the requirements of the machine.

FIG. 381.



The relative proportion between the water raised, and that wasted, is entirely dependent upon the fall or source of supply, that is to say, from the top of the trunk as at S to the foot-valve C, Fig. 368, and the height to which the water is required to be raised.

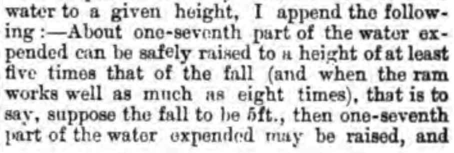
Of course, as in all cases where long lengths of pipe are used (especially when of small bore), friction must be taken into consideration.

I generally allow for rising main pipes from ½in. to 1in. bore, 1ft. pressure for every 100 yards of piping, that is to say, if the rising main be 1,000 yards long I allow 10ft. extra pressure, *or 5lbs. the square inch extra on the surface of the water in the air chamber*, to overcome the friction in such pipes. If the pipes be 1¼in. to 2in., I only allow half this amount, simply because there is not the same amount of friction in large pipes as in the smaller ones, the friction being in exact proportion to the size of bore. My advice is, always to use pipes large enough for the work.

Let us go back to the fall, and examine what is actually necessary to get a certain required amount of work. Some will say that if they had a head of say 10ft., they would make use of the whole, not having to lift the water more than 30ft. I may say that a fall of 10ft. is ample to throw one-fourteenth of the water expended to height of 140ft., and I may add that it is quite possible to fix a ram under a head of 10ft. and yet get no more work than from under a 5ft. or 6ft. head.

If this be the case, there must of necessity be a lot of useless wear and tear on an ill-proportioned ram. This being so, it requires the judgment of the plumber to select a ram which is suitable to his fall, so that the wear and tear of the machine may be in strict proportion to the amount of work done, and the economy in keeping the ram in repair will be in accordance.

FIG. 382.



In order that my readers may calculate what fall is required to safely work a ram to drive water to a given height, I append the following:—About one-seventh part of the water expended can be safely raised to a height of at least five times that of the fall (and when the ram works well as much as eight times), that is to say, suppose the fall to be 5ft., then one-seventh part of the water expended may be raised, and which will equal one-seventh part to a height of 25ft., as before said. You can get more, but this is safe reckoning. And, further, I may add that one-fourteenth part of the water expended may be raised to a height of ten times that of the fall, and so on in proportion. To make this quite clear, so that no misunderstanding may arise, I will give another illustration as follows:—If the ram be placed under a head, say, of 5ft. of water upon the trunk, then for every seven gallons drawn from the head one gallon may, and should be sent through the rising main to a height of 25ft., or half a gallon to the height of 50ft., or,

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this same order of explosions by influence, which are rapidly propagated to a great number of caps.

It follows, then, from these facts, and especially from the experiments made under water, that the explosions by influence are not due to a burning, properly so called, but to the transmission of a shock arising from the enormous and sudden pressures produced by the nitro-glycerine on gun-cotton. In an extremely rapid reaction, the pressures may approach to the limit which corresponds to the matter detonating in its own volume, and the commotion due to the sudden development of almost theoretical pressures can be propagated both through the ground and by supports as intermediary or through the air itself, projected *en masse*, as has been shown by the explosion of certain powder factories and of gun-cotton magazines, and even by some of the experiments with dynamite and compressed gun-cotton. The intensity of the shock propagated either by a column of air or by a liquid or solid mass, varies with the nature of the explosive body and its mode of inflammation: it is of greater violence according as the length of the chemical reaction is shorter and develops more gas, that is to say, a higher initial pressure, and more heat, that is to say, work, for the same weight of explosive material. This transmission of a shock is conveyed better by solids than by liquids, better by liquids than by gases; with gases it is better, as they are more compressed. Through solids it is better propagated according to their degree of hardness, iron transmitting it better than earth, and hard ground better than ploughed soil. All breaks of continuity in the transmitting material tend to weaken it, especially if a softer substance is interposed. It is in this manner that the use of a tube as a receiver, made from a goose quill, stops the effect of mercury fulminate, while a tube or a capsule of copper transmits this effect in all its intensity. The explosions by influence are the better propagated in a series of cartridges according as the envelope of the first detonating cartridge is the more resisting, which allows the gases to attain a greater pressure before the covering is destroyed. The existence of an empty space, that is to say, filled with air, between the fulminate and the dynamite, on the other hand, diminishes the violence of the shock transmitted, and in consequence that of the explosion: generally the effects of breaking powders are lessened when there is no contact.

To form a full conception of the transmission of sudden pressures which produce shock by the supporting medium, it is desirable to recall this general principle, in virtue of which in a homogeneous mass, pressures are transmitted equally in all directions and are the same on a small element of surface whatever its position. Detonations produced under water with gun-cotton show that this principle is equally applicable to the sudden pressures which produce the explosive phenomena. But it ceases to be true when one passes from one medium to another.

If the inert chemical matter which transmits the explosive movement is fixed in a given situation on the surface of the ground, or better, on the surface of the rail on which the first cartridge was placed, or better still, held by the pressure of a mass of deep water, in the midst of which the first detonation is produced, the propagation of the movement in this matter will hardly be able to take place except under the form of a wave of a purely physical order, and in consequence of a character essentially different from the first wave of a chemical and physical order, at the same time developed in the explosive body itself. This new wave propagates concussion away from the explosive centre, all around it, and with an intensity which decreases inversely as the square of the distance. Even in the neighbourhood of the centre, the displacements of the molecules may break the cohesion of the mass and disperse it, or crush it by enlarging the chamber of explosion, if the operation is conducted in a cavity. But a very short distance, and of which the magnitude depends on the elasticity of the surrounding medium, these movements, confused at the beginning, regulate themselves in order to produce a wave, properly so called. Characterised by compression and sudden deformations of the material, the amplitude of these oscillations depend upon the magnitude of the initial impulse. They move with a very great rapidity, and preserve their regularity up to the point where the medium is broken. Then these compressions and sudden deformations change their nature and are transformed into a movement of impulse, that is to say, that they reproduce the shock. If then they act on a new cartridge they may determine its explosion; the shock will be otherwise weakened by the distance, and in consequence the character of the explosion may be modified. The effects diminish in this manner up to a certain point, from which the explosion ceases to produce itself.

When this occurs on a second cartridge the same series of effects will be produced from the second to the third cartridge; but they depend on the character of the explosion of the second cartridge. nd thus it goes on.

Such is the theory that appears to me to explain explosions by influence and the phenomena which accompany them. It depends, definitely, on the production of two orders of waves: one series represents the explosive waves, properly so called, developed in the midst of the matter which detonates, and consisting of a continual reproduction of the transformation of the chemical actions into caloric and mechanical action, which transmits the shock to the support and to the contiguous bodies; the other is a purely mechanical and physical series, and which also transmits the sudden pressures all round the centre of the concussion to the adjoining bodies, and by a singular circumstance to a new mass of explosive material.

A theory differing from this was originally proposed by Abel; that is to say, the theory of *Synchronous vibrations*, to which we shall now direct our attention. According to this English savant, the originating course of the detonation of an explosive lies in the synchronism, between the vibrations produced by the body which provokes the detonation, and those which the first body would produce in detonating, precisely as a violin string resounds at a distance in unison with another vibrating chord. Prof. Abel has cited the following facts in support of his theory. To begin with, the detonators appear to differ with each variety of explosive. For instance, nitrogen iodide, so susceptible to shock or friction, cannot cause the detonation of compressed gun-cotton. Nitrogen chloride, so easily exploded, will not produce the same detonation, except when ten times the weight of the necessary fulminate is used. In the same way nitro-glycerine will not produce a detonation of gun-cotton in sheets on which is placed the envelope in which it is contained. In this way nitro-glycerine up to 23·3 grains can be detonated without success. On the other hand, the inverse influence is proved; 7·75 grains of compressed gun-cotton having caused the detonation at a distance of 25mm. of nitro-glycerine wrapped up in an envelope of thin sheet iron. A cap filled with a mixture of potassium ferrocyanide and potassium chlorate, similarly (according to Brown), will not detonate gun-cotton. Finally, a cap consisting of a mixture of mercury fulminate and potassium chlorate, should be used of much heavier weight than if it were filled with the pure fulminate, (according to Franzl). Nevertheless, the heat given off by the same weight is greater by one-fifth than that with the first mixture.

Messrs. Chapman and Pellett have brought to the support of this ingenious hypothesis the following experiments: they attached to the strings of a double bass particles of nitrogen iodide, a substance which detonates on the slightest friction. Then they made the strings of a similar instrument vibrate at a short distance off. A detonation was produced, but only for sounds higher than a certain note, which corresponds to 60 vibrations per second. They also took two conjugate parabolic mirrors placed 2·5 meters apart and they arranged along the line of foci at different points several drops of nitro-glycerine or of nitrogen-iodide; then they detonated at one of the foci a large drop of nitro-glycerine; they observed that the explosive substances placed in the conjugated foci detonated in unison to the exclusion of the same substances placed at other points. A layer of lampblack placed on the surface of the mirrors was designed to prevent the reflection and the concentration of the calorific rays.

As yet none of the experiments appear to me to be conclusive, and several of them seem even to be formally opposed to the theory. We shall begin by observing that the speciality of a given musical note, capable of determining each variety of explosion, has never been established; it is only below a certain note that the effects cease to be produced, while they take place by preference, and whatever the explosive bodies may be, by the action of the most acute notes. Besides, these effects cease to produce themselves at distances which are incomparably less than the resources of the chords in unison, which goes to prove that the detonations are functions of the intensity of the mechanical action, rather than of the character itself of the determining vibration. Similarly, the detonation ceases to be produced when the weight of the detonator is too slight, and in consequence when the living force of the shock is weakened. Nevertheless, the special vibratory note which determines the explosions should always remain the same. For instance, cartridges filled with 75 per cent. of dynamite cease to detonate when the capsule contains a weight of fulminate less than 0·2 grains; the detonation not being certain in all cases except by the regulation weight of one grain. This confirms the existence of a direct relation between the character of the detonation and the intensity of the shock produced by one and the same detonator. If it is true that gun-cotton will cause the nitro-glycerine to detonate in consequence of the synchronism of the vibration communicated, then we do not understand why the reciprocal action does not take place, while the absence of reciprocity can be easily explained by the difference of the structure of the two substances which play so important a part in the transformation of the living force into work.

This same diversity of structure and the modifications which it introduces into the transmission of the phenomena of shock and with the transformation of mechanical energy into caloric energy, may be called upon to explain the facts observed by Abel. The difference between the energy of pure fulminate and of the fulminate mixed with potassium chlorate is no less easily explained; the shock produced by the first body being sharper on account of the absence of all dissociation of the product, which is no other than carbon monoxide, this absence should be opposed to the dissociation of carbon dioxide formed in the second case. Perhaps, also, the formation of potassium chloride disseminated through the gas produced with the aid of potassium chlorate weakens the shock, just the same as silicon does in the case of dynamite.

All the effects observed with the nitrogen-iodide may be explained by the vibration of the supports and by the effects of rubbing which results therefrom, this substance being particularly sensitive to friction. The experiment with the conjugate mirrors may also be easily explained by the concentration in the foci of the movements of the air, and therefore of the mechanical effects which result. Besides, M. Lambert has proved by experiments made for the commission of explosive substances, that the explosion of dynamite cartridges being produced in tubes of cast iron of large diameter, it does not appear to have, from the standpoint of detonations provoked by influence, any difference between the vibratory motions and nodes characteristic of the tube. Desiring to clear up this entire question by removing it from the influence of the supports and of the diversity of cohesion and physical structure of solid explosive substances, I undertook a series of special experiments on the chemical stability of matter in a sonorous vibration and especially on that of gaseous bodies such as ozone or hydrogen, arsenide or liquids, such as hydrogen feroxide, or persulphuric acid, all of the bodies being selected from among those which decompose or change spontaneously, and that at ordinary temperatures with the disengagement of heat, precisely similar to explosive substances. The description of these experiments may be found in the *Comptes Rendus* or in the *Revue Scientifique*, May, 1880. They lead to the conclusion that substances which are transformable with the disengagement of heat, are stable under the influence of soundwaves, while they are decomposed under the influence of ethereal vibrations. This diversity in the mode of action of the two classes of vibrations is not surprising when we consider that the sharpest sonorous vibrations are incomparably slower than the luminous or calorific vibrations.

Nevertheless, it appears certain that the propagation of explosions by influence is not made in virtue of an undulatory movement, a complex movement of a chemical and physical order in the midst of the explosive substance which is decomposed, whilst it is purely physical in the midst of intermediary substances which suffer no decomposition. But that which distinguishes this sort of movement of the vibrations, properly so called, is, first of all, its extreme intensity; that is to say, the magnitude of the living force which it transmits; it is also the unique character of the explosive wave, which is propagated in opposition to the multiplicity of successive sonorous waves. Finally it is essential to observe that the explosive material does not detonate because it transmits the movement, but on the contrary because it arrests, and because it transforms on the spot the mechanical energy into calorific energy capable of suddenly raising the temperature of the substance up to the degree which will produce its decomposition.

MOULDING A JACKETED CYLINDER.*

At the left of the engraving is shown a section of a jacketed cylinder, which will be recognized by the practised moulder as being a somewhat difficult casting to make. The outside of the casting is a simple affair enough, the difficulties being confined almost entirely to the centre core, which is shown in section on the right, together with the sweep and other accessories used in its making.

In making the mould the outside was made first, not because it is customary to do so, but because it it had to be built up and dried in a pit, from a lack of oven room. At K is shown the bottom plate; also a holding down hook, of which there are four. The plate was set on a solid sand foundation, and in order to leave a pit below a cast-iron ring F was used. The pit was required to provide room for a man to operate screws for centring the centre core, as will be explained further on.

In making the outside mould there were five 6in. round blocks distributed so as to equally divide the circumference, for making vent holes as at H. At mechanically added. Through the centre of the case extends a shaft, and on the face of the case, in a circle drawn from the shaft centre, are inscribed a series of figures, from 0 to 99, inclusive, consecutively, as shown, and rigidly secured to the front end of the shaft is a hand or pointer, which is kept in its initial position at 0 against a stop by a coiled spring. Two circular discs mounted loosely on the shaft are peripherally numbered. The disc which registers units and tens is provided with a flange on the inside of which are cut ratchet teeth, which register with and correspond in number to the numbers on the periphery of the discs. Into these ratchet teeth a spring pawl which is secured to the arm catches. When the pointer is turned to the right, the disc remains stationary; but when the pointer is turned to the left, the pawl engages with one of the ratchet teeth and revolves the disc with the shaft. The second disc is loosely mounted upon the shaft at a suitable distance from the first disc and, like it, is peripherally numbered. Projecting from its inner face are a hundred tappet pins, which register with the numbers inscribed upon the periphery.

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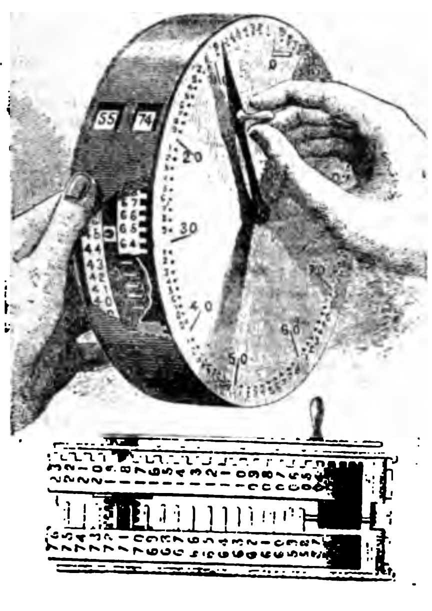
* By Thos. D. West, in the American Machinist.

The first disc is provided with a spring tappet rod which projects from its outer face, and is so situated as to be normally out of contact with the tappet pins on the second disc. This tappet rod moves the second disc one number each time it is brought into operation. The normal position of the machine is when the pointer is at 0 and the ciphers on the discs register with the apertures in the case. In adding a number of figures—as, for example, 20, 17, and, 13—the pointer will be turned from 0 on the dial to the left until it reaches 20, and then released, and the spring, E, allowed to carry back to 0, then to the left again to 17, and so on for the next number, and, owing to the pawl and ratchet teeth previously described, the disc, F, will be revolved from point to point, and the sum "50" will appear through the units and tens aperture. When the sum of the figures added equals or exceeds 100, the second disc will be also moved one point, or as many times as there are hundreds in the sum, and the amount will be read through both apertures, as will be very readily understood.—*Scientific American.*



SOME UNSOLVED PROBLEMS IN GEOLOGY.

THE American Association for the Advancement of Science held its annual meeting at Minneapolis, in August last, and as usual the retiring president delivered an address, of which the following is an abstract. After some preliminary remarks in which he pointed out that science must be limited on all sides by unsolved mysteries, Principal Dawson, LL.D., F.R.S., commenced his subject by asking:—

What do we know of the oldest and most primitive rocks? At this moment the question may be answered in many and discordant ways; yet the leading elements of the answer may be given very simply. The oldest rock formation known to geologists is the lower Laurentian, the fundamental gneiss, the Lewisian formation of Scotland, the Ottawa gneiss of Canada. This formation of enormous thickness corresponds to what the older geologists called the fundamental granite,—a name not to be scouted, for gneiss is only a stratified granite. Perhaps the main fact in relation to this old rock is that it is a gneiss; that is, a rock at once bedded and crystalline, and having for its dominant ingredient the mineral orthoclase—a compound of silica, alumina, and potash—in which are imbedded, as in a paste, grains and crystals of quartz and hornblende. We know very well, from its texture and composition, that it cannot be a product of mere heat; and being a bedded rock, we infer that it was laid down layer by layer, in the manner of aqueous deposits. On the other hand, its chemical composition is quite different from that of the muds, sands, and gravels usually deposited from water. Their special characters are caused by the fact that they have resulted from the slow decay of rocks like these gneisses, under the operation of carbonic acid and water, whereby the alkaline matter and the more soluble part of the silica have been washed away, leaving a residue mainly siliceous and aluminous. Such more modern rocks tell of dry land subjected to atmospheric decay and rainwash. If they have any direct relation to the old gneisses, they are their grandchildren, not their parents. On the contrary, the oldest gneisses show no pebbles, or sand, or limestone—nothing to indicate that there was then land undergoing atmospheric waste, or shores with sand and gravel. For all that we know to the contrary, these old gneisses may have been deposited in a shoreless sea, holding in solution or suspension merely what it could derive from a submerged crust recently cooled from a state of fusion; still thin, and exuding here and there through its fissures heated waters and volcanic products.

It is scarcely necessary to say that I have no confidence in the supposition of unlike composition of the earth's mass on different sides, on which Dana has partly based his theory of the origin of continents. The most probable conception seems to be that of Lyell; namely, a molten mass, uniform except in so far as denser material might exist toward its centre, and a crust, at first approximately even and homogeneous, and subsequently thrown into great bendings upward and downward.

In short, the fundamental gneiss of the lower Laurentian may have been the first rock ever formed; and in any case it is a rock formed under conditions which have not since recurred, except locally. It constitutes the first and best example of these chemico-physical, aqueous, or aqueo-igneous rocks, so characteristic of the earliest period of the earth's history. Viewed in this way, the lower Laurentian gneiss is probably the oldest kind of rock we shall ever know—the limit to our backward progress, beyond which there remains nothing to the geologist except physical hypotheses respecting a cooling, incandescent globe.

In the next succeeding formation, the true lower Laurentian of Logan, the Grenville series of Canada, we meet with a great and significant change. It is true, we have still a predominance of gneisses which may have been formed in the same manner with those below them: but we find these now associated with great beds of limestone and dolomite, which must have been formed by the separation of calcium and magnesium carbonates from the sea water, either by chemical precipitation or by the agency of living beings. We have also quartzite, quartzose gneisses, and even pebble beds, which inform us of sandbanks and shores. Nay, more, we have beds containing graphite, which must be the residue of plants, and iron ores which tell of the deoxidation of iron oxide by organic matters. In short, here we have evidence of new factors in world-building,—of land and ocean, of atmospheric decay of rocks, of deoxidising processes carried on by vegetable life on the land and in the waters, of limestone-building in the sea. To afford material for such rocks, the old Ottawa gneiss must have been lifted up into continents and mountain masses. Under the slow but sure action of the carbonic dioxide dissolved in rain-water, its felspar had crumbled down in the course of ages. Its potash, soda, lime, magnesia, and part of its silica, had been washed into the sea, there to enter into new combinations, and to form new deposits. The crumbling residue of fine clay and sand had been also washed down into the borders of the ocean, and had been there deposited in beds. Thus the earth had entered into a new phase, which continues onward through the geological ages; and I place in your hands one key for unlocking the mystery of the world when I affirm that this great change took place, this new era was inaugurated, in the midst of the Laurentian period.

This is also a proper place to say something of the doctrine of what is termed "metamorphism." The Laurentian rocks are undoubtedly greatly changed from their original state, more especially in the matters of crystallisation and the formation of disseminated minerals by the action of heat and heated water. Sandstones have thus passed into quartzites, clays into slates and schists, limestones into marbles. So far, metamorphism is not a doubtful question; but, when theories of metamorphism go so far as to suppose an actual change of one element for another, they go beyond the bounds of chemical credibility; yet such theories of metamorphism are often boldly advanced, and made the basis of important conclusions.

The Grenville series, or middle Laurentian, is succeeded by what Logan in Canada called the upper Laurentian, and which other geologists have called the Norite or Norian series. Here we still have our old friends the gneisses, but somewhat peculiar in type; and associated with them are great beds rich in lime-felspar,—the so-called labradorite and anorthite rocks. The precise origin of these is uncertain, but this much seems clear: namely, that they originated in circumstances in which the great limestones deposited in the lower or middle Laurentian were beginning to be employed in the manufacture, probably by aqueo-igneous agencies, of lime-felspars. This proves the Norian rocks to be much younger than the Laurentian, and that, as Logan supposed, considerable earth-movements had occurred between the two, implying lapse of time.

Next we have the Huronian of Logan,—a series much less crystalline and more fragmentary, and affording more evidence of land elevation and atmospheric and aqueous erosion than any of the others.

Still later than the Huronian is the great micaceous series called by Hunt the Mont Alban or White Mountain group, and the Taconian or Taconic of Emmons, which recalls in some measure the conditions of the Huronian. The precise relations of these to the later formations, and to certain doubtful deposits around Lake Superior, can scarcely be said to be settled, though it would seem that they are all older than the fossiliferous Cambrian rocks which practically constitute the base of the Palæozoic.

After what has been said, you will perhaps not be astonished that a great geological battle rages over the old crystalline rocks. By some geologists they are almost entirely explained away, or referred to igneous action or to the alteration of ordinary sediments. Under the treatment of another school, they grow to great series of pre-Cambrian rocks, constituting vast systems of formations, distinguishable from each other, not by fossils, but by differences of mineral character.

After the solitary appearance of Eozoon in the Laurentian, and of a few uncertain forms in the Huronian and Taconian, we find ourselves in the Cambrian, in the presence of a nearly complete invertebrate fauna of protozoa, polyps, echinoderms, molluscs, and crustacea; and this not confined to one locality merely, but apparently extending simultaneously throughout the ocean. This sudden incoming of animal life, along with the subsequent introduction of successive groups of invertebrates, and finally of vertebrate animals, furnishes one of the greatest of the unsolved problems of geology, which geologists were wont to settle by the supposition of successive creations. In an address delivered at the Detroit meeting of the Association in 1875, I endeavoured to set forth the facts as to this succession, and the general principles involved in it, and to show the insufficiency of the theories of evolution suggested by biologists to give any substantial aid to the geologist in these questions. In looking again at the points there set forth, I find they have not been invalidated by subsequent discoveries, and that we are still nearly in the same position with respect to these great questions that we were in at that time,—a singular proof of the impotency of that deductive method of reasoning which has become fashionable among naturalists of late. Yet the discussions of recent years have thrown some additional light on these matters; and none more so than the mild disclaimers with which my friend Dr. Asa Gray and other moderate and scientific evolutionists have met the extreme views of such men as Romanes, Haeckel, Lubbock, and Grant Allen. It may be useful to note some of these as shedding a little light on this dark corner of our unsolved problems.

It has been urged, on the side of rational evolution, that this hypothesis does not profess to give an explanation of the absolute origin of life on our planet, or even of the original organisation of a single cell or of a simple mass of protoplasm, living or dead. All experimental attempts to produce by synthesis the complex albuminous substances, or to obtain the living from the non-living, have so far been fruitless; and, indeed, we cannot imagine any process by which such changes could be effected. That they have been effected we know; but the process employed by their Maker is still as mysterious to us as it probably was to him who wrote the words, "And God said, Let the waters swarm with swarmers." How vast is the gap in our knowledge and our practical power implied in this admission, which must, however, be made by every mind not absolutely blinded by a superstitious belief in those forms of words which too often pass current as philosophy.

But if we are content to start with a number of organisms ready made—a somewhat humiliating start, however—we still have to ask, How do these vary so as to give new species? It is a singular illusion in this matter, of men who profess to be believers in natural law, that variation may be boundless, aimless, and fortuitous, and that it is by spontaneous selection from varieties thus produced that development arises. But surely the suppos that of mere chance and magic is unworthy of science. Varieties must have causes, and their causes and their effects must be regulated by some law or laws. Now, it is easy to see that they cannot be caused by a mere innate tendency in the organism itself. Every organism is so nicely equilibrated, that it has no such spontaneous tendency, except within the limits set by its growth and the law of its periodical changes. There may, however, be equilibrium more or less stable. I believe all attempts hitherto made have failed to account for the fixity of certain, nay, of very many, types throughout geological time; but the mere consideration that one may be in a more stable state of equilibrium than another so far explains it. A rocking stone has no more spontaneous tendency to move than an ordinary boulder, but it may be made to move with a touch. So it probably is with organisms. But, if so, then the causes of variation are external, as in many cases we actually know them to be; and they must depend on instability or change in surroundings, and this so arranged as not to be too extreme in amount, and to operate in some determinate direction. Observe how remarkable the unity of the adjustments involved in such a supposition. How superior they must be to our rude and always more or less unsuccessful attempts to produce and carry forward varieties and races in definite directions! This cannot be chance. If it exists, it must depend on plans deeply laid in the nature of things, else it would be most monstrous magic and causeless miracle. Still more certain is this conclusion when we consider the vast and orderly succession made known to us by geology, and which must have been regulated by fixed laws, only a few of which are as yet known to us.

Certain recent utterances of eminent scientific men in England and France are most instructive with reference to the difficulties which encompass this subject. Huxley, at present the leader of English evolutionists, in his "Rede Lecture" delivered at Cambridge, England, holds that there are only two "possible alternative hypotheses" as to the origin of species—(1) that of "construction," or the mechanical putting-together of the materials and parts of each new species separately; and (2) that of "evolution,,' or that one form of life "proceeded from another" by the "establishment of small successive differences." After comparing these modes, much to the disadvantage of the first, he concludes with the statement that "this was his case for evolution, which he rested wholly on arguments of the kind he had adduced"; these arguments being the threadbare false analogy of ordinary reproduction and the transformation of species, and the mere succession of forms more or less similar in geological time, neither of them having any bearing whatever on the origin of any species or on the cause of the observed succession. With reference to the two alternatives, while it is true that no certain evidence has yet been obtained—either by experiment, observation, or sound induction—as to the mode of origin of any species, enough is known to show that there are numerous possible methods, grouped usually under the heads of absolute creation, mediate creation, critical evolution, and gradual evolution. It is also true that almost the only thing we certainly know in the matter is that the differences characteristic of classes, orders, genera, and species, must have arisen, not in one or two, but in many ways. An instructive commentary on the capacity of our age to deal with these great questions is afforded by the fact that this little piece of clever mental gymnastics should have been practised in a university lecture and in presence of an educated audience. It is also deserving of notice, that, though the lecturer takes the development of the Nautili and their allies as his principal illustration, he evidently attaches no weight to the argument in the opposite sense deduced by Barrande—the man of all others most profoundly acquainted with these animals—from the palæozoic cephalopods.

Another example is afforded by a lecture recently delivered at the Royal Institution in London by Professor Flower. The subject is "The Whales, Past and Present, and their Probable Origin." He gives up at once, as every anatomist must, the idea of an origin from fishes or reptiles. He thinks the ancestors of the whales must have been quadrupedal mammals. He is obliged for good reasons to reject the seals and the otters, and turns to the ungulates, though here, also, the difficulties are formidable. Finally he has recourse to an imaginary ancestor, supposed to have haunted marshes and rivers of the Mesozic age, and to have been intermediate between a hippopotamus and a dolphin, and omnivorous in diet. As this animal is altogether unknown to geology or zoology, and not much less difficult to account for than the whales themselves, he very properly adds, "Please to recollect, however, that his is a mere speculation"

Another caution which a paleontologist has occasion to give with regard to theories of life has reference to the tendency of biologists to infer that animals and plants were introduced under embryonic forms, and at first in few and imperfect species. *Facts do not substantiate this. The first appearance* of leading types of life is rarely embryonic. On the contrary, they often appear in highly perfect and specialised forms; often, however, of composite type, and expressing characters afterwards so separated as to belong to higher groups. The trilobites of the Cambrian are some of them of few segments, and, so far, embryonic; but the greater part are many-segmented, and very complex. The batrachians of the carboniferous present many characters higher than those of their modern successors, and now appropriated to the true reptiles. The reptiles of the Permian and trias usurped some of the prerogatives of the mammals. The ferns, lycopods, and equisetums of the Devonian and Carboniferous were, to say the least, not inferior to their modern representatives. The shell-bearing cephalopods of the Palæozoic would seem to have possessed structures now special to a higher group, that of the cuttle-fishes. The bald and contemptuous negation of these facts by Haeckel and other biologists does not tend to give geologists much confidence in their dicta.

There is one other unsolved problem, in the study of life by the geologist, to which it is still necessary to advert. This is the inability of palæontology to fill up the gaps in the chain of being. In this respects, we are constantly taunted with the imperfection of the record; but facts show that this is much more complete than is generally supposed. Over long periods of time and many lines of being we have a nearly continuous chain; and, if this does not show the tendency desired, the fault is as likely to be in the theory as in the record. On the other hand, the abrupt and simultaneous appearance of new types in many specific and generic forms, and over wide and separate areas at one and the same time, is too often repeated to be accidental. Hence palæontologists, in endeavouring to establish evolution, have been obliged to assume periods of exceptional activity in the introduction of species, alternating with others of stagnation—a doctrine differing very little from that of special creation as held by the older geologists.

So soon as we find evidence of continents and oceans, we raise the question, "Have these continents existed from the first in their present position and form, or have the land and water changed places in the course of geological time? In reality both statements are true in a certain limited sense. On the one hand, any geological map whatever suffices to show that the general outline of the existing land began to be formed in the first and oldest crumplings of the crust. On the other hand, the greater part of the surface of the land consists of marine sediments which must have been derived from land that has perished in the process, while all the continental surfaces, except, perhaps, some high peaks and ridges, have been many times submerged. Both of these apparently contradictory statements are true; and, without assuming both, it is impossible to explain the existing contours and reliefs of the surface.

In the case of North America, the form of the old nucleus of Laurentian rock in the north already marks out that of the finished continent, and the successive later formations have been laid upon the edges of this, like the successive loads of earth dumped over an embankment. But in order to give the great thickness of the Palæozoic sediments, the land must have been again and again submerged, and for long periods of time. Thus, in one sense, the continents have been fixed; in another, they have been constantly fluctuating.

The causes and mode of operation of the great movements of the earth's crust which have produced mountains, plains, and tablelands, are still involved in some mystery. One patent cause is the unequal settling of the crust towards the centre; but it is not so generally understood as it should be that the greater settlement of the ocean bed has necessitated its pressure against the sides of the continents in the same manner that a huge icefloe crushes a ship or a pier. The geological map of North America shows this at a glance, and impresses us with the fact that large portions of the earth's crust have not only been folded, but bodily pushed back for great distances. On looking at the extreme north, we see that the great Laurentian mass of central Newfoundland has acted as a protecting pier to the space immediately west of it, and has caused the Gulf of St. Lawrence to remain an undisturbed area since Palæozoic times. Immediately to the south of this, Nova Scotia and New Brunswick are folded back. Still farther south, as Guyot has shown, the old sediments have been crushed in sharp folds against the Adirondack mass, which has sheltered the tableland of the Catskills and of the Great Lakes. South of this again, the rocks of Pennsylvania and Maryland have been driven back in a great curve to the west. Nothing, I think, can more forcibly show the enormous pressure to which the edges of the continents have been exposed, and at the same time the great sinking of the ocean beds. Complex and difficult to calculate though these movements of plication are, they are more intelligible than the apparently regular pulsations of the flat continental areas, whereby they have alternately been below and above the waters, and which must have depended on somewhat regular recurring causes, connected either with the secu cooling of the earth, or with the gradual retar tion of its rotation, or with both. Throughout t changes, each successive elevation exposed rocks for long ages to the decomposing influenc the atmosphere. Each submergence swept aw and deposited as sediment, the material accumula by decay. Every change of elevation was acco panied with changes of climate and with mod cations of the habitats of animals and plants. W it possible to restore accurately the phys geography of the earth in all these respects, for e geological period, the data for the solution of m difficult questions would be furnished.

Principal Dawson then spoke of the controv with regard to the formation of coal, and of respecting the so-called fucoids of the ancient ro He then gave the landmarks of the great Gla epoch, and proceeded:—

No conclusions of geology seem more certain t that great changes of climate have occurred in course of geological time; and the evidence of in that comparatively modern period which mediately preceded the human age is so stri that it has come to be known as pre-eminently ice age, while, in the preceding tertiary peri temperate conditions seem to have prevailed e to the Pole. Of the many theories as to t changes which have been proposed, two seem present to divide the suffrages of geologists, ei alone, or combined with each other. These (1) the theory of the precession of the equinoxe connection with the varying eccentricity of earth's orbit, advocated more especially by Cr and (2) the different distribution of land and w as affecting the reception and radiation of heat the ocean currents,—a theory ably propounded Lyell, and subsequently extensively adopted, ei alone or with the previous one. One of these vi may be called the astronomical; the other, geographical.

If, however, we are to adopt the geograph theory, we must avoid extreme views; and leads to the inquiry as to the evidence to be fo for any such universal and extreme glaciation demanded by some geologists.

The only large continental area in the north hemisphere supposed to be entirely ice and sn clad is Greenland; and this, so far as it goes certainly a local case, for the ice and snow Greenland extend to the south as far as 60° latitude, while both in Norway and in the inte of North America the climate in that latitude mits the growth of cereals. Further, Grin Land, which is separated from North Greenl only by a narrow sound, has a comparatively climate, and, as Nares has shown, is covered verdure in summer. Still further, Nordenskj one of the most experienced Arctic explorers, that it is probable that the interior of Greenlan itself verdant in summer, and is at this mom preparing to attempt to reach this interior o Nor is it difficult, with the aid of the facts cite Woeikoff and Whitney, to perceive the cause of exceptional condition of Greenland. To giv and snow in large quantities, two conditions required,—first, atmospheric humidity; secondly, cold precipitating regions. Both of t conditions meet in Greenland. Its high co ranges receive and condense the humidity from sea on both sides of it and to the south. Hence vast accumulation of its coast snow-fields, and intense discharge of the glaciers emptying out o valleys. When extreme glacialists point to Gre land, and ask us to believe that in the glacial the whole continent of North America as far so as the latitude of 40° was covered with a contine glacier, in some places several thousands of thick, we may well ask, first, what evidence t is that Greenland, or even the Antartic contin at present shows such a condition; and, secon whether there exists a possibility that the inte of a great continent could ever receive so large amount of precipitation as that required. So as present knowledge exists, it is certain that meteorologist and the physicist must answer questions in the negative. In short, perpe snow and glaciers must be local, and canno continental, because of the vast amount of poration and condensation required. These only be possible where comparatively warm supply moisture to cold and elevated land; and supply cannot, in the nature of things, penet far inland. The actual condition of interior and interior America in the higher northern latitu affords positive proof of this. In a state of pa submergence of our northern continents, we readily imagine glaciation by the combined ac of local glaciers and great ice-floes; but, in wh ever way the phenomena of the boulder clay an the so-called terminal moraines are to be accou for, the theory of a continuous continental gla must be given up.

Recently the opinion has been gaining gro that the close of the ice age is very recent. reasons as the following lead to this conclus the amount of atmospheric decay of rocks an denudation in general, which have occurred the close of the glacial period, are scarcely preciable; little erosion of river-valleys or of coast-terraces has occurred. The calculated recession of waterfalls and of production of lake-ridges leads to the same conclusion. So do the recent state of bones and shells in the Pleistocene deposits, and the perfectly modern species of their fossils. On such evidence the cessation of the glacial cold and settlement of our continents at their present levels are events which may have occurred not more than six thousand or seven thousand years ago, though such time estimates are proverbially uncertain in geology. This subject also carries with it the greatest of all geological problems, next to that of the origin of life; namely, the origin and early history of man. Such questions cannot be discussed in the closing sentences of an hour's address. I shall only draw from them one practical inference. Since the comparatively short post-glacial and recent periods apparently include the whole of human history, we are but new-comers on the earth, and therefore have had little opportunity to solve the great problems which it presents to us. But this is not all. Geology as a science scarcely dates from a century ago. We have reason for surprise in these circumstances that it has learned so much, but for equal surprise that so many persons appear to think it a complete and full-grown science, and that it is entitled to speak with confidence on all the great mysteries of the earth that have been hidden from the generations before us. Such being the newness of man and of his science of the earth, it is not too much to say that humility, hard work in collecting facts, and abstinence from hasty generalisation, should characterise geologists, at least for a few generations to come.

SILVER PRINTS MOUNTED ON GLASS—MEDALLIONS, AND HOW TO PRODUCE THEM.*

TWENTY years have elapsed since Mr. Rawlinson, as well as Mr. Tunny in Scotland, mounted photographs on glass plates by means of gelatine, much in the same manner as we practise the process to-day; and shortly afterwards Mr. V. Blanchard described his method of stripping the photograph from a glass plate previously collodionised. The method proposed by the latter gentleman has been in use all over the civilised world almost daily since its publication, but the former was allowed to lie dormant, or nearly so, until the energy of Mr. Payne Jennings and a few other exhibitors brought it once more to the fore. Briefly, the prints to be treated should be printed darker than for ordinary mounting, care being taken not to tone them very much, or a cold blue or grey tone will be the result when finished. The glass plate intended for the reception of the print should be free from scratches or blisters, and must be most carefully polished with rouge, tripoli, or the usual polishing mixture. It is then placed on a water oven or heated over a gas-flame or other contrivance, until it can be comfortably borne on the back of the hand. Hot gelatine solution—1 part gelatine to 15 parts water—should next be poured in a pool on the warm plate, and equally distributed over its surface by means of a glass rod; the prints, which are slightly smaller than the glass plate, are withdrawn from a weak solution of gelatine (1 part gelatine to 40 parts of water) and placed, albumenised side downwards, on the gelatinised glass plate, when it will be found that a good squeegeeing will remove the excess. When dry, the operation is complete. As a matter of fact, so largely have photographers availed themselves of this method of exhibiting their own productions, that it would be difficult to find a place of importance where the process is not employed. And here we may mention that we have noticed, in a few instances where show-cases have been exposed to considerable variations of temperature, including the full force of the sun's rays, portions of the photographs have dragged away from the glass support, and in a short time showed unmistakable signs of fading, while the parts still adhering appeared comparatively fresh. There is always a danger of the print coming up in patches unless the glass plate is thoroughly well polished, and as the instances we speak of were all pictures of large size, doubtless the defect was due to imperfect polishing.

A further development of this process is to be seen in the medallions, as they are called; that is to say, photographs surrounded with black varnish and a metal rim.

By abrading the back of the print with fine glass paper, as recommended in the crystoleum process, it is possible, especially with landscapes, to produce a certain amount of coloured effects by means of liquid dyes in alcohol, and in many cases we have seen good results. When portraits, however, are so treated, they are seldom all that can be desired, the main difficulty being to get the proper depth of tint. The only difficulty likely to be encountered in the production of these pictures will be with the gelatine. Temperature, as in carbon printing, play an important part. 65° F. will be found the most satisfactory temperature for the coating and drying-room, and every precaution should be taken to obtain that result, or failures are sure to follow. Having regulated the temperature, the following articles will be required:—A flat tin dish for dissolving the gelatine, arranged over a Fletcher air burner gas-stove, and a similar dish for soaking the prints in the melted and filtered gelatine: also a jug for pouring the solution over the glass plate, arranged over a fine jet of sufficient heat to prevent the solution cooling; a Wedgwood funnel, into the neck of which is placed a piece of clean wet sponge, answers well for filtering; a glass rod for distributing the gelatine over the plate; a rubber squeegee, and a piece of American cloth to protect the print while squeegeeing; strips of wood an inch broad, of any length, two such strips joined by cross-pieces forming racks for drying; padded blocks of the same size and shape as the medallions will be useful (the pad forms a cushion for the glass, while the raised surface allows of passing the burnishing tool quickly round when fastening down the rim); a stock of prints trimmed to the desired size and shape. In the majority of cases, from one to two inches margin of clear glass is allowed, this margin being afterwards filled in with Bate's dead-black varnish, as described below. A stock of oval dome-top or other shape glasses; suitable backs for these shapes fitted with rings; metal rims to fit: Bates' dead-black varnish; Young's patent size, as sold at the oilman's, completes the list.

Melting the gelatine:—Cover the bottom of the tin with size broken up into small pieces. Enough cold water is poured over to cover the pieces, when the temperature is raised to nearly 200° Fahrenheit, to insure perfect solution. When melted, a portion of the solution is passed through the sponge into the second dish for soaking the prints, and the remaining portion is passed into the jug, and kept hot by the means above stated. A well-polished plate is heated to 100° F., placed on a level slab, and covered with a pool of hot size. Should the solution prove refractory, the glass rod will assist spreading. Quickly transfer a soaked print from the second dish of hot size to its position, face down, on the plate, and roughly squeegee; remove the excess with a sponge, and again apply the squeegee, this time interposing a piece of American cloth to protect the print. If no air-bells are seen when examined from the front, the plate is placed on the rack to dry, paper side uppermost, which in a good current of dry air will occupy a couple of hours. When dry, the back should receive a second coating in like manner, another two hours being required before the next operation. When the second coating is quite dry, a brush well charged with Bates' black is passed round the margin, completely coating the bare glass, care being exercised not to allow the varnish to overlap the photograph more than is really necessary; thirty minutes' drying will remove the last traces of tackiness, and no more remains to be done than to fit the back, adjust the metal rim, and secure it down neatly with a burnishing tool to the padded block.

Landscapes and figure studies, nicely vignetted to the edge of the plate, are very effective when mounted as described above, on oval glass plates, in which case the use of black varnish is, of course, dispensed with.

Mason Science College.—The Mason Science College, which begins its new session on the 23rd of October, was open three years ago, and during the first session 95 students (65 males and 30 females) were registered. In the session just ended there were 366 students (229 males and 137 females). The courses of instruction are framed with a view to prepare students for the various examinations in arts and in science of the University of London. At the same time a large number of students are pursuing different branches of science with a view to their application to manufacturing or other purposes. By an arrangement with Queen's College (the Birmingham Medical School) all their students attend this college for the purpose of obtaining instruction in chemistry, botany, and physiology. At the end of the first term (February, 1881) there were about 3,000 volumes in the library. At the present time there are upwards of 14,000 volumes, including the best works for each department of the college. The council have spared no expense in acquiring apparatus and specimens in order adequately to illustrate the various courses of lectures.

THE most successful makers of malleable castings in the United States use pig that is very free from phosphorus or sulphur, as either hot shortness or cold shortness will spoil the castings. The metal is melted in crucibles of 50lb. to 100lb. capacity, keeping the air out. The metal should be hot enough for a drop withdrawn on an iron bar to burn on exposure to the air. The cementation is done in iron boxes, the castings being bedded in powdered hematite or in iron peroxide, and kept from three to fifteen days, according to thickness. This is a greater length of time than is found necessary in this country.

SCIENTIFIC NEWS.

FROM Dun Echt Circular, No. 78, we learn that a telegram was received from Prof. Kruger at 9 a.m. on Sept. 6, stating that a suspicious object was discovered by Brooks on Sept. 2, which was observed by Wendell, and found to be a comet. Its place was Sept. 3, 16h. 9m. 24·5s. G.M.T., R.A. 16h. 35m. 15·6s.; N. Dec. 64° 49' 33'. The daily motion is — 36s. and — 12'. The physical appearance is circular, less than 1' diameter, 10th mag., well defined nucleus; no tail. It may be of interest to mention that the words of the message actually sent by the Science Observer Code commenced with "unmerited unmusical Brooks unbaptised unnerved Wendell," &c.

The annual report by Prof. Adams of the work done at Cambridge University Observatory has been published for the information of the members of the Senate. Comet Wells was observed up to May 31, 1882, and altogether 182 comparisons with neighbouring stars were made. Of the Great Comet, 1882 *b*, 306 comparisons were made, and 150 of Comet 1883 *a* (Brooks-Swift). The weather entirely prevented any observation of the transit of Venus. From three places of Comet *a*, 1883, Mr. Graham calculated a parabolic orbit which almost exactly reproduces the middle place; and in correspondence with Dr. Carl Stechert, of Berlin, some good work has been done in connection with the orbit of Schäberle's Comet, 1881 *e*.

The directors of the Ben Nevis Observatory have appointed Mr. R. T. Omond, of Edinburgh University, superintendent of the observatory which is to be built on the summit of the mountain. Two assistants will be appointed shortly, and the three observers will then take up their station and prepare to enter on the work of the coming winter. The highest section of the path to the summit is finished, and the building of the permanent observatory has been commenced, horses being employed to carry up the materials. During the winter the work will consist mostly of eye observations, the object being to collect information regarding the climate of the Ben, with the view of deciding what automatic and other instruments will be required for making the various observations in the permanent buildings. Mr. Buchan has been asked to visit the more important meteorological observatories on the Continent, especially those at high levels, and report on the instruments in use to the directors, so that by next summer the Ben Nevis Observatory may be fully and adequately equipped.

The next meeting of the American Association for the Advancement of Science will be held early in September at Philadelphia. The president elect is Dr. J. P. Leslie, of Philadelphia.

M. Hutinet, with Prof. Stebbing, has been visiting many of the principal cities and towns to enable photographers to judge of his simple method of enlarging, and of the value of his improved gelatino-bromide paper, which is said to be so prepared that every sheet can be relied upon to be exactly like any other. The lantern used is a simple square metallic body, with double bent and screened chimney, and an ordinary argand gas-burner. A silvered reflector is connected to the back, and in front of the flame is a sheet of ground glass separating the lantern from the camera. The latter is of simple construction, but is provided with a slot, through which to pass the negative immediately in front of the glass plate. A sheet of cardboard placed in front of the objective (a few feet), serves to show when the picture is sharp and clear, and also as a support for the prepared paper. According to the rapidity of the lens used the exposure is from one to five minutes; but with any ordinarily good carte lens, a minute and a half is sufficient. Ferrous-oxalate is used for development. The process has given satisfaction wherever shown, and, whatever professionals may do with it, will be welcomed by amateurs. The gelatino-bromide paper is patented in all countries.

Last Monday Messrs. Gilbert, Bogle, and Co., of Glasgow, tried one of their electric launches on the Clyde at Kilcreggan. It was driven by Clark's patent battery and motor, Mr. Clark managing the machinery and also steering the boat. The only other persons on board were Mr. Bogle and Major MacIver, for whose inspection the trip was made. Major Maclivcr, who had with him a 15ft. launch, built by Powell and Douglas, of Waukegan, Illinois, has ordered it to be fitted with Clark's machinery. If the experiment be successful, Messrs. Bogle are to construct a much larger vessel for him, to make the trip from the North Sea to the Black Sea, through the Rhine and Danube and their artificial junction. The large boat will be designed for a speed of ten miles an hour, and it will take several months to construct her, but the smaller one will probably be seen on the Thames before the end of October. Major Maclivcr believes that he can make the trip from sea to sea in about three weeks.

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* Extracted from an article in the *Photographic News*.

The autumn meeting of the Iron and Steel Institute, like the annual meeting of the British Association, commences next week, the former being held at Middlesbrough, commencing on the 18th, the latter at Southport, on the 19th. Amongst the important papers to be read at the former will be those on the manufacture of coke on the Simon-Carvès system by Mr. R. Dixon, and on the Jameson system by Mr. J. Jameson; Mr. I. L. Bell's on the "Use of Raw Coal in the Blast Furnace," and Mr. Smith-Casson's on "Recent Results with Gas Puddling Furnaces." The excursions and visits are, however, the chief attractions of the meeting.

M. B. Renault brought before the Académie des Sciences on the 20th of August "A Contribution to the History of the Formation of Coal." He concludes that coal is, in many cases, produced by the transformation of the constituent elements of the plants the forms of which are preserved, and that both wood and bark have entered into the formation of coal, condensed in proportion to the primitive density of the carbon element.

M. Chevreul, the famous French chemist, entered his ninety-eighth year the other day. He was born August 31, 1786.

A Mr. Watkins, a Clerkenwell manufacturer, has, according to the *Times*, invented a motor for the sewing machine. It consists of a "length of steel tape," which as it is wound up forms itself into a "parabolic spiral," and thus dispenses with the compensating arrangement of the fusee. According to our contemporary, the "tape" is wound up by a winch handle, a few turns of which will store up sufficient energy for an hour's work or more! The action is completely under control; the needle attains a rate of between 900 and 1,000 stitches a minute, or can be made "to work so slowly that the machine scarcely moves."

The "first consignment" of burning-oil from the petroleum wells of Batoum has been landed in Birkenhead.

According to the latest accounts of M. Marcel Deprez's experiments at Grenoble, the results of the attempts to transmit power over a distance of nearly nine miles by means of conductors of silicium bronze show a return of only 15 per cent.

The Rev. L. L. Langstroth, at a meeting of the Montgomery Co. (Ohio) Horticultural Society, recommended the cultivation of golden rod and wild asters on waste land, as bees will forsake almost any plant if they can find either within distance.

Rules for Reckoning Postage. Mr. C. L. Dodgson of Christ Church, Oxford, gives the following rules: Book Post. Find the number of ounces. Take the first even number not less than this and halve it. This gives the cost in halfpence. Letter Post. A letter not over 1oz. costs 1d. Otherwise use last rule and add 1d. Parcel Post.—Find the number of pounds and add one. Take the first even number not less than this and halve it. This gives the cost in threepenny-pieces. N.B. A book must not be over 5lb. nor a parcel over 7lb. A letter over 12oz. is charged 1d. an ounce, beginning with the first ounce. Examples for a book of 5½oz., say "5½, 6, 3 halfpence." For a letter of 5½oz., say "5½, 6, 3 halfpence, and a penny makes 2½d." For a parcel of 5½lb., say "5½, 6½, 8, 4 threepenny-pieces make 1s."

ADAMANTONITE is the local name of a mineral which is said to be found in only one place in the world, and that in the State of Missouri. The *Scientific American* says the stone is very peculiar in its structure and properties. Its cutting power is diamond like, cutting away steel very rapidly, and still retaining an exceedingly fine edge.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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THOUGHT READING — ATTACHING FOSSILS TO CARDBOARD—POSITIVE RELIEF INSTEAD OF "NEGATIVE" WASTE OF MONEY—LOW BAROMETER—THE LATE MR. C. F. VARLEY —OBSERVING STARS IN DAYLIGHT —SYMBOLS FOR FEET AND INCHES —THE MANUFACTURE OF OBJECT-GLASSES—NOT KNOWING WHERE TO STOP—THE DETERIORATION OF PRINTING—SHADOW OR MIRAGE?—MICROSCOPIC—THE "ENGLISH MECHANIC" AND TIME — CHINESE WHITE—LEVELLING.

[21795.]—HOLDING, as I do, a very definite opinion indeed, myself, as to the (so-called) "transfer of thought" or "thought-reading," I will yet, for the sake of argument, admit it to be a real and objective phenomenon. Having made such admission though, I rather fail to see the difficulty started by "F. W. H." in letter 21747 (Vol. XXXVII., p. 602); because if we conceive thought to consist in, say, molecular vibrations of the brain, it seems more likely that such vibrations should set up corresponding ones in a similarly constituted piece of organic mechanism than that an immaterial entity (if I may employ such a form of expression) should go outside of the only apparatus through, which we have, or can have, any cognisance of its actions—and moreover, in fact, it can conceivably act at all—to impress another similar entity. If a man will sound a chord upon a musical instrument, stopped tubes or stretched strings in the room will each take up its own special rate of vibration, and reproduce it in the form of a specific note; but the performer might *think* of a tune until doomsday without producing the faintest effect in the shape of musical sound on any resonant body whatever. If "thought-reading" be not mere trickery performed by persons either deceiving or self-deceived, it seems to me that it must have its origin in material action. I do not see any necessity for importing the vagaries of theologians into the discussion at all.

"R. R. R." (query 51526, Vol. XXXVII., p. 610) will find that very thick gum-water will fasten fossil shells to cards capitally. I have also glued pretty large fossils (such, for example, as the Euomphalus) on to pieces of board.

"The Government," says Reuter's telegram dated from Simla, "has decided to start famine relief works in the northern provinces, owing to the drought prevailing there." Surely this is a much more legitimate expenditure of public funds than the sending out of any person or persons to take negatives of sunspots: to be forwarded home that some charlatan or other may, by "reducing and discussing them," pretend to predict the advent of famine seasons in the Indian Peninsula.

At 1 p.m. on Sunday, the 2nd inst., during the very heavy gale which then blew, the barometer in my hall (unreduced) stood at 28·683in. I can find no record of a lower reading in my register.

The late Mr. C. F. Varley, whose death is announced in your "Scientific News" on p. 11, presented one of those psychological puzzles which serve to illustrate the truth of the well-known words, "Great wit to madness nearly is allied." A man of great intellectual capacity and high scientific attainments, he was yet the credulous dupe of those most shallow and impudent of all impostors, the Spiritualist "Media." Anyone who may wish to see to what a depth of fatuity a man of great ability may descend, need only turn to p. 62 of your XIXth Volume, and read the account of the elaborate way in which Mr. Varley tried how not to find out Miss Cook's method of performing her barefaced and impudent tricks. The manner in which her paltry deception was at once detected by common-sense investigators may be read in Vol. XXX., p. 502.

In connection with letter 21768 (p. 12), I may just remark that it is by no means necessary to employ an 11½in. reflector to see stars in the daytime. I constantly get the time in sunlight from stars of the 1st and 2nd magnitudes in a 2¾in. transit instrument. I merely mention this to encourage in an interesting kind of observation those who might be deterred by the supposition that it could only be pursued with such large telescopes as that of Mr. Franks.

While heartily endorsing the well-timed protest made by Mr. Hopkins (in letter 21782, p. 15), against the misuse of the symbols ′ and ″. I am not sure that his suggested method of indicating feet and inches would be advantageous. That °, ′, and ″ should be employed in their original signification of degree, minutes, and seconds of arc *alone*, everyone having the smallest regard for scientific accuracy must admit. As it is, we constantly find architectural and mechanical draughtsmen using ′ and ″ for feet and inches; and what is, if possible, worse, I have known an astronomer (?) to write ′ and ″ for minutes and seconds of time! The confusion which might thus be made between, say, 42m. 36·8s. and 42′ 36·8″ Longitude East, need merely be mentioned to be obvious. Having said which, it only remains to add that my chief objection to Mr. Hopkins's suggested symbols is that both π and δ have already very definite significations attached to them, π standing for the number 3·14159265, &c., and δ for Declination. I do not see why people cannot write ft. for feet and in. for inches. These unmistakeable marks of quantity are very nearly as easily written as ′ and ″ themselves.

What "Bow" quotes (in letter 21784, p. 16) from "an old book," is, I believe, still substantially true as far as the objectives of a very large proportion of pocket telescopes are concerned. Lenses, I have been told, are ground in Paris in hundreds of thousands, and are fitted together in the way described.

Apropos of "Bow's" antepenultimate paragraph, I agree with him thoroughly about the punctuation in Vol. IV. of the "Turning and Mechanical Manipulation." A good deal of it induces a reminiscence of the story of the gentleman who, volunteering to read the Lessons in church, rather astonished the congregation by proclaiming that "The wicked flee, when no man pursueth but the righteous, is as bold as a lion": thus seemingly attributing an amount of bravery to a noxious insect with which it has previously not been credited.

I have little doubt that "A Practical Printer" (letter 21791, p. 17) is right in his conjecture as to the cause of the typographic difference between the two works to which I referred. The "Short History of the English People" is printed upon much thinner and poorer paper than the first edition of "The Ipswich Lectures." I find, too, in comparing Herschel's "Astronomy" (in Lardner's Cyclopædia) with Proctor's "Moon," as requested by your correspondent, that the latter work certainly does not show any falling off; albeit the edition of the "Outlines" (Sir J. H.'s expansion of his original work in Lardner), published in 1875, is decidedly worse printed, on the whole, than that was. I suspect that the "Outlines" must be printed from stereotyped plates too.

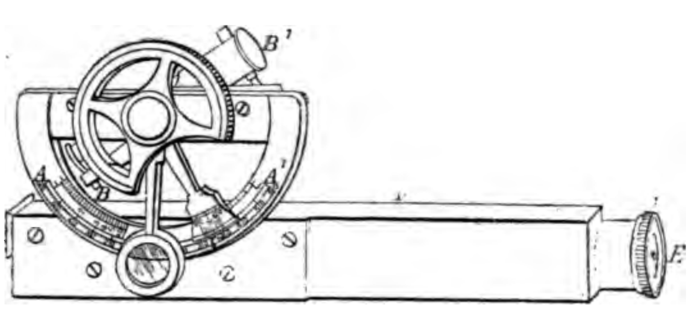
I do not understand the *inversion* of the second shadow referred to by Mr. Ratcliffe, in letter 21792 (p. 17); but the oblique reflection of the sun's rays from the surface of the water would obviously suffice to cast a second shadow in the position indicated.

Reading query 51564 (p. 22), one is curious to know how "L. B. B." determined the value of the divisions in his eyepiece micrometer.

"Salvo Jure" (query 51595, p. 23,) will find that a very little glycerine will keep Chinese white moist and workable. I fancy that Chinese white is zinc oxide.

From a rough calculation, made in connection with query 51574 (p. 22), I find that Vol. CXXXV. will be the first one of the ENGLISH MECHANIC that will terminate in June. Number one of it will be published on Friday, January 5th, 1933, and its twenty-sixth number on Friday, the 29th of the subsequent month of June.

"E. E. R. T." (query 51611, p. 23), will find a dumpy level, such as Elliotts manufacture, the best for rough work abroad. Abney's level, of which I subjoin a drawing, is a very ingenious form of reflecting instrument, which is carried in the pocket, and held in the hand for use. It consists mainly of a tube, T, furnished with an eyehole at E. In the top of this tube is an opening, and within the tube, and half filling it, is a mirror inclined at an angle of 45°. A bubble tube, B B′, set hollow, so that the light can shine through it, has its bubble reflected down into the mirror, when the vernier, V, marks 0° 0′ on the arc, A A′, and the tube is horizontal. If, then, we look through the eyehole, and find any object under these circumstances coincident with the bubble image, such object must be on a level with the observer's eye. Pretty evidently, too, if we direct the tube to any



object above or below the level of the eye, and move the vernier until the reflected image of the bubble comes into coincidence with the object we are looking at, its angle of elevation or depression may be read off by inspection on the arc. I suppose that a builder's level is one of the bubble tubes mounted in a long mahogany box, with a brass bottom, that one sees; unless, indeed, it be the square, with a plumb line, used by bricklayers. Your correspondent should get that excellent eighteenpenny-worth, No. 170 of Weale's Series, published by Crosby Lockwood and Co., London.

A Fellow of the Royal Astronomical Society.

ASTRONOMICAL—δ EQUULEI.

[21796.]—The faint pair of stars in the field with β Cephei, alluded to by Mr. Holmes (letter 21731, page 578), was first mentioned by Σ, but has never been catalogued or measured. I saw it easily some years ago with the 3¼in. Sheepshanks refractor, power 64, the observations being made within four miles of Charing-cross. There is a minute pair mentioned by Webb (Σ 541 *rej.*) between $\kappa^1 \kappa^2$ Tauri, which I have just seen with a power of 64 on this aperture; with 150 it is an easy object. Σ estimates the mag. at 9·10: De, who speaks of it as being extremely difficult with 7¼in., at 11·2, 11·6; but these last are considerably underrated. By "640" Cygni, I presume Mr. Holmes means Ħh 640 (Ħ.N. 110 = So. 726): the decl. of which is 11′ too large in Webb. The minute pairs near this, χ Cygni, and δ Cephei, do not appear in any catalogue; the number of faint Galactic pairs is well nigh innumerable. Mr. Holmes should give the estimated magnitudes, pos. angles, and distances of any new pairs he may chance to find, as well as the approximate differences of R.A. and δ referred to some known star; but faint coarse pairs are not worth cataloguing.

It may interest some of your readers to know that Mr. Burnham has lately made an observation of that wonderful binary, δ Equulei, by which he has been able to determine approximately the period. Hitherto all the observations have been made about the opposite extremities of the orbit, and the stars are so nearly equal in a telescope of 15in. aperture, that it has been impossible, as the motion has seemed so nearly rectilinear, to decide whether the time of revolution was 13-14 years, or only half that number. Mr. Burnham, however, has just shown me a rough diagram of this object, which has served, with the aid of his latest measure, to determine the direction and rate of the motion. The period is about 13 years, and the present distance of the two components is, he tells me, certainly not over 0·25″. This is the most rapid binary known up to the present time, the next being 42 Comæ (Σ 1728), with a period (according to Dubiago) of 25¾ years. The following observations of δ Equulei, by Profs. Winlock and Peters, seem to have escaped notice:—

195·57°: (0·44″): 1869·745 (6 nights).

The measures were made with the 15in. refractor at Harvard, powers 633 to 2004, the stars being just separated on one occasion with 1243. With the exception of this observation and two somewhat doubtful ones of Dunér's this most difficult object seems only to have been seen at Pulkova, Madison, and Chicago. Perhaps the Rev. J. J. M. Perry, who I trust has not altogether abandoned double-star observation, will see what he can do with this? β Delphini is still very close, the distance being only 0·25″, or perhaps even less; it is evidently a binary of short period, probably under 30 years.

September 8. **H. S.**

[21797.]—I am honoured by the notice of the Rev. T. W. Webb. Allow me to explain that "β Cephei × 500" was intended to express as seen with a power of 500, the power being obtained with a ¼in. Steinheil solid eyepiece and a Barlow lens on a 9in. mirror of 75in. focus. The faint pair were in the field with this power.

There is a very interesting group near 31 Ħ in Cassiopeia. When 31 is in field of low power, a triangle of stars is following in same field. Due north of triangle is a patch which a power of 90 or 100 shows nicely. It consists of from 10 to 11 mag. in a straight line, and three rather brighter following at a small angle to the line of the first. The four are about equally distant, and I estimate about 3″ to 4″ apart. The preceding star of the four is a close double—the companion preceding—and the following star of the four is also a double, a little wider and fainter, with the companion following. I estimate these two little companions as of the 13th and 14th mag., but the night was not clear. It appears to me there would be a great deal of difficulty in doing any useful work in the direction indicated by the Rev. T. W. Webb in London, from the great variations of the atmosphere. Not only does this differ from hour to hour, but even at the same hour with an apparently clear sky: stars in one direction will be tolerably sharp, and in another fuzzy. Last night, for instance, ζ Herculis was pretty sharp and good, but at same time doubling the 7·5 mag. of 101 Cassiopeiæ was quite a feat. The faint companion to 60 Cygni was obvious, while β Cygni was two nebulous patches; and the night before, when 429 Cygni was beautifully clear 2624 was very doubtfully double. How to allow for this inequality of air is a puzzle to me.

I should be glad to know what I may regard as the smallest star visible with a 9in. mirror. Of course, a considerable discount must be allowed for London air, for I am satisfied that 6in. a few miles away will show as much as 8in. in London, and show it much more pleasantly. In fact, I think 6in. is about as large an aperture as is useful in London. **Edwin Holmes.**

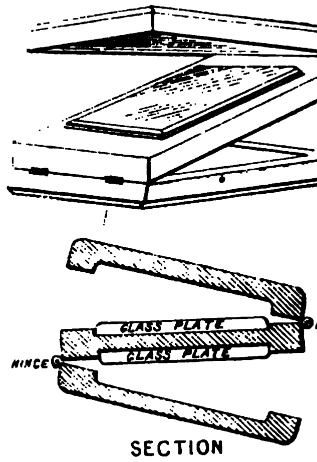
DAYLIGHT PLANETARY OBSERVATIONS.

[21798.]—This morning being remarkably clear, I determined to utilise the opportunity of doing a little telescopic work. Having opened the observatory shutters soon after 7 o'clock, I picked up *Saturn* by 7.15, two hours after sunrise. The planet was pale, but very beautiful, bearing a power of 160. The shadow of ball on ring, principal division in ring, and the dusky ring where it crossed the ball, were well seen. The ring has opened perceptibly since last season, and now extends just beyond the ball. The greater yellowness of the ball as compared with the ring was obvious enough. *Mars* at 7.25, very bright, and its orange tint conspicuous; it bore a power of 300 well. The gibbosity on *p.* limb very plain, the N. pole cap and some dusky markings seen, but its diameter of 7″ not enough to identify them. This is certainly the next planet to Venus for brilliancy in sunlight. *Jupiter* at 7.35, a little pale, but looked noble with 160; all the belts well seen, the S. equatorial one especially strong. The colour of the planet was white, with a faint tinge of yellow, very similar to that of Venus, only, of course, incomparably paler. The vivid blueness of the sky background might possibly affect the whiteness of an object in daylight, giving its complementary tint of yellow to it. *Venus* at 9.5 a.m., well defined and excessively bright, now only 11 days from superior conjunction. I have used two methods of reducing the distressing glare of light in the sun's vicinity. One is to employ a light neutral-tint moon cap with full aperture; the other is to use a very small eccentric stop (I have a revolving diaphragm for solar observation, with various apertures from 2¼in. to 4½in., which answers capitally). The latter plan is preferable, giving steadier definition. Powers of 160 and 240 were used, and, in extra steady moments, I suspected some departure from uniform illumination, but nothing definite enough to sketch. *Mercury* at 1.25 p.m., about dichotomised, but perhaps slightly concave; terminator very irregular. It would not well bear a high power, being very fluttering, and only occasionally steady. The colour of this object, carefully noticed with various eyepieces (and on the 4th and 8th inst., as well as the present occasion) was decidedly a dull yellow. In 1877 I had noted it, as seen with 5in. o.g., pale white in the daytime. But I am disposed to give more weight to the present observations, made with an instrument of four times the light-grasping power, and free from the disturbing effect of chromatic aberration. It is seldom one gets such an opportunity of comparing together all the five planets of the ancients in the broad light of day. In relative brightness the sequence was:—Venus, Mars, Jupiter, Mercury, Saturn—though in the case of Jupiter and Mercury the order might be reversed if Jupiter was *south* and Mercury *north* of the sun. In the *Nautical Almanac* the ephemeris of Jupiter, "at transit at Greenwich," only begins on Sept. 22nd, for the present season—whereas it was plainly visible a month earlier, as it passed the meridian here, with my 11¼in. telescope. I may add that Castor was seen this morning at 8.20, marvellously wide, like two points; and the difference of magnitudes was apparently greater than at night, at least 0·7m.

Sept. 9th, 1883. **W. S. Franks.**

HANDY SURFACE PLATE BLOCK.

[21799.]—I beg to call the attention of amateurs to the useful surface plate sketched below. It is made as follows:—A piece of plate glass, ¼in. thick by 12in. by 4in. is procured at a glass warehouse, and divided into three pieces, making each about 4in. square. One side of each piece is then surfaced on each other with a little fine emery and oil, thus: No. 1, for sake of clearness, is rubbed in little circular motions on No. 2; then No. 2 is taken to rub on No. 3; No. 3 on No. 1, and so on, ringing the changes on the three till either lies perfectly flat on its neighbour. Mount two of the best plates in a suitable case with plaster of Paris, of course bevelling and grinding the edges of the glass on a sandstone with water, to give a finished appearance to the job. The remaining plate can be kept by for rough surfacing, or to take the place of one of the two in the case should either happen to get broken.



SECTION

HANDY SURFACING BLOCK AND CASE

I often use an arrangement substantially the same as this for sharpening my slide-rest tools and cutters, also any small surfacing I have to do, and have no reason to do away with an old friend for one of Whitworth's, or any similar make. I should like our friend "A., Liverpool," to try surfacing small work on the above little affair, and also on a piece of wood, no matter how nicely it is planed up, and kindly give us the benefit of his experience, as I notice on page 582, he recommends the latter plan, and also scraping. The scraper, when properly used, is, I admit, very good for bringing up large work to surface; but when you have an awkward little piece that you can scarcely hold in your fingers to surface, the best way is to work it up on the plate. When using this surfacing-block one side should be used with fine emery and oil to bring the work up to a face, and the other side used with clean oil only to finish the work off smooth. This is my way of surfacing slide-valves, port faces, and any small part requiring an absolutely flat surface.

It is not necessary that this surfacing block should be mounted as shown. Any other way would answer just as well, provided the glass is not subject to undue strain in the mounting. I simply send this as an arrangement which I think would answer most purposes of the amateur engineer.

A. Austel.

BERTHELOT ON EXPLOSIVES—STAR CATALOGUES.

[21800.]—In No. IV. of the admirable series of articles on "Explosives," page 10, the subject of "Explosion by Influence" is treated upon. Allow me to mention a case which did not follow the usual rule. On the 29th ult., I accompanied a friend to destroy a cartridge of Nobel's gelatinised nitro-glycerine. The cartridge was placed on the grass, and in close contact with it a "primer" of the same material, in which the usual fulminating detonator was firmly pressed, and a piece of fuse attached. The detonator exploded the primer all right, but not the main cartridge. The latter simply ignited, and burnt away with great fierceness. It might be supposed that the detonator was too weak, but this could scarcely be the case, for we had previously exploded two, three, and four cartridges together with detonators from the same packet, taking no precaution to tie the cartridges, but simply laying them side by side. In this instance, however, I did place a stone on each side, to prevent the cartridges from rolling apart. On examining the spot directly afterwards, it appeared, from the burnt grass, as if the main cartridge had been blown aside by the initial explosion and ignited, instead of exploding as we expected. Can any brother reader who has had a larger experience throw any light on the matter?

With respect to Mr. Holmes's remarks on "Star Catalogues" (21451, p. [illegible]), I should think that Proctor's "Handbook of the Stars" would be the most useful to "R. K. P.," and certainly there is nothing cheaper. The "B. A. C." is a splendid catalogue, containing 8,377 stars, down to 7 mag. generally, although a few lower ones are included; yet there are a goodly number of naked-eye stars not mentioned in it, to my knowledge. The places of stars, however, are given with great precision, and also the constants for reduction; the epoch is 1850. But its great drawback is the extremely loose manner in which the [illegible] are expressed; these are utterly untrustworthy. Added to which the catalogue is out of print, very scarce, and commands a high price. The "Catalogue" of Heis, accompanying his "Atlas Cœlestis," would be preferable, inasmuch as its author is our greatest authority on the subject of magnitudes. It contains 5,422 stars, arranged in constellations, for epoch 1855. But the places are only given to nearest minute of arc, both in decl. and R.A., and there are no precessional constants. Moreover the expression of R.A. in ° and ′, instead of in time, is highly inconvenient. Some copies of this work have two pages of corrigenda; but, besides these, a very long list was published by Professor Peirce, "Annals of Harvard College Observatory," Vol. IX. Personally, I prefer the Greenwich Catalogues for star places, and these volumes may often be bought at a secondhand bookseller's, whilst I trust to Heis and Argelander for magnitudes. I know of no one catalogue that fulfils all the desired conditions, or I should have obtained it long ago. There is just one statement by Mr. Holmes, if he will pardon my mentioning it, where he says — "The drawback is that there are *hundreds* of stars not visible to the naked eye not included in the maps." The italics are mine. This refers to the large atlas of Proctor, if I mistake not the preceding sentence. There may be some [illegible] of such stars (and I have come across not a few myself), but [illegible] is "too much" even for my indulgent belief! If Mr. H. will excuse me, I think that his labour would be better expended upon the conversion of his alt-azimuth stand into an equatorial one, and then he would require no such elaborate maps. May I tell him, though strictly *sub rosa*, that I have heard a whisper of a new "Star Atlas," that is to eclipse all predecessors, being in course of preparation!

September 7th. **W. S. Franks.**

SQUARE NUMBERS.

(Continued from No. 961, [illegible].)

[21801.]—The squares of the natural numbers 1, 2, 3, 4, . . ., are worthy of consideration. The series 1^2, 2^2, 3^2, 4^2, 5^2, . . . includes all integral squares. Taking the differences of the squares in the order in which they stand, we get the series of odd numbers 1, 3, 5, 7, . . ., from which we see at a glance that every odd number is the difference of two squares. Hence every odd square is the difference of two squares. 25, for example, is the difference of the squares 144 and 169, which are found by adding and subtracting one from the given square and dividing by two, thus 26 ÷ 2 and 24 ÷ 2 give 13 and 12, then we get $13^2 - 12^2 = 5^2$. Also two squares whose difference is 81, will be $(82 \div 2)^2$ and $(80 \div 2)^2$ or $41^2 - 40^2 = 81 = 9^2$.

Taking the differences of the ultimate terms of the series, we get the series 8, 12, 16, . . ., which are all multiples of 4; it follows that every multiple of 4 is the difference of two squares. To find the squares for any given difference, divide by 4, then add and subtract 1 for the roots. Thus 12 ÷ 4 = 3, adding 1 and subtracting 1, we get the roots 2 and 4, whence $4^2 - 2^2 = 12$. If the difference is 100, then 100 ÷ 4 = 25, from which we get $26^2 - 24^2 = 100$. We may state here that the geometric series, 1, 2, 4, 8, 16, . . ., if every term is multiplied *by the sum of two squares, each of them will also be the sum of two squares, and every term after the second being a multiple of 4, will also be the difference of two squares.* Multiplying the series by 10, which is the sum of two squares, it becomes [illegible]. [illegible] Now [illegible] = 14 − [illegible], the sum of two squares and [illegible] = [illegible] − [illegible], the difference of two squares, from which we deduce [illegible] = [illegible] − [illegible].

The odd number [illegible] is the difference of 2 squares, and [illegible] it is easy to see that [illegible] = [illegible]. From these equations we get [illegible]. From this, treated in the same way, we find a square the sum of [illegible] squares, namely [illegible]. Again—

[illegible]

L. S.

ARCTIC COLD.

[illegible]—Having been unable before to answer Mr. Lancaster (letter [illegible]), I trust you will allow me a few lines in reply to same. Mr. Lancaster says, "the whole question seems to me to be most easily solved when we consider what does really take place." And that is just what we ought to consider, for I think the problem is not solved yet. For instance, why do not those enormous sudden changes occur more regularly, oftener, or periodically? Because an ordinary Polar current would not change the temperature to such a great extent and in such a short space of time, especially from 54° down to 10° or 12° Fahr., or even lower. That I will prove presently, and anybody who has spent some time in the far North will agree with me. Here I will give a few facts. First. Why does not the Pole, or rather why do not the Polar currents, issue the same amount of cold each winter? Someone would answer, "The wind has been south." No, that is not the case; for it is known that the wind has been blowing from the north for weeks, and still the cold has been very moderate (that is experienced in Norway, in the north of Sweden and Russia, and even Spitzbergen and other north-lying places can have very moderate cold some years. Secondly. Why do not the Polar currents issue the same amount of cold for each mile, or ten miles, they traverse? Because the nearer they arrive towards the south the more cold they lose? No, that is not the case, one place lying 10 or 40 miles more south than another may have 10° or 15° more cold than a place lying so many miles more north, although at both places the wind has been full north. Thirdly. Does Mr. Lancaster believe that he can get ice an inch and a half thick in 12 hours, in a temperature of 30° Fahr.? No, that is simply impossible, at least in the north of Sweden, the 5th of October, and anywhere else, where temperature has never been lower than 54° for the previous six months. The temperature (as far as I can recollect) was at 7 a.m. 8° Fahr., but it may have been still lower. Fourthly. The same amount of cold which came on so suddenly at the beginning of October, should certainly have lowered the quicksilver to 4° Fahr., or perhaps 2° Fahr., if it had been in January instead of October. That may seem strange; but that is the case, and I will explain it presently, if somebody should not know, or perhaps have never thought of it. Still, we cannot so easily detect it in England as one may do in the more north-lying countries. We know that the earth absorbs a great deal of solar heat during the summer. Now, Mr. Lancaster says, heat radiated from the earth is retarded or absorbed by a moist atmosphere, and is not absorbed by a (perfectly) dry atmosphere. This, of course, is impossible to find in nature.

Does Mr. Lancaster mean that we cannot see the radiation of the heat from the earth? If so, I will prove that he is not correct. After a warm summer day, a cool night may set in; the cool atmosphere is rushing down toward the hot surface of the earth, and, coming in contact with the earth, the cool air is condensed into steam, which gradually settles down on the ground in drops—what we call dewdrops. Or, as is more plainly seen in the North in the autumn, especially if the night is very cool, or the cool season sets in very suddenly. In the morning the rivers or lakes look full of steam, caused by the cooler atmosphere coming in contact with the much warmer water. So an ordinary Polar current (excuse me for using the word "ordinary") could not possibly produce such an enormous change in the atmosphere in such a short time as 12 hours. It must be, at certain times, some kind of revolutions in the Polar regions, or, at least, in the Polar currents, which bring such a great quantity of cold to one single spot, say, within a radius of from 300 to 800 or 900 miles or more. Therefore such a great change would be, I should think, impossible, at the beginning of October, with our ordinary Polar currents, and that for the simple reason that, at such an early date, the earth still possesses so great an amount of heat that the radiation of such heat would take longer than 12 hours to absorb and equalise the temperature of the atmosphere and the earth. Mark me, I have spoken about the plains of Northern Europe, and not the Alps. Anybody who has experience of cold climates where the quicksilver has been frozen hard as a stone in the morning, and in the evening the thermometer has shown over 50°, will agree with me that the vast difference between two such extremities is still something for our learned professors to explain.

Hot and Cold.

FREE REEDS.

[21803.]—As I wish to supplement the remarks on p. 14 of our new volume, I should like to draw the attention of Mr. Child to the wonderful effect produced by the application of what are known as the patent qualifying tubes, which are used in the reed organs manufactured by the Clough and Warren Organ Company of America. These tubes, which are constructed of wood, have the effect of increasing the volume, power, and quality of tone from the sets of reeds to which they are applied. This, at least, is one experiment which has been tried, and proved successful. This fact also proves that the tubes can be made to influence the quality of tone, if at present the tubes do not influence the tone, the reason of which is because (as I remarked before) they are made to one scale throughout the organ. As such is the case, how can the tubes be expected to have any influence on the tone? The popular or general idea is that the tubes are of little or no consequence—that is, with regard to their influence on the tone; and as I have practically proved this idea to be erroneous, I must differ.

G. Fryer.

[21804.]—I do not know what is meant by the phrase, "eventually contradict" (p. 14); and certainly my letter on p. 603 was not intended to contradict the statements of Mr. Fryer, for that would be a work of supererogation. It is quite true that Mr. Fryer said on p. 580 he had "proved by practical experiment that characteristic tone can be obtained without voicing the reeds"; but he considered the experiment evidently so great a discovery—as, indeed, it is—that he forgot to tell your readers how he arrived at it. I can promise your correspondent that if he will only explain definitely "how it's done" he will have one attentive reader; but he must really let a little more light into the matter than he does on p. 14. Mr. Fryer's first statement was that the size and position of the tubes necessitated voicing; now he says that, according to his experiments, "voicing the reeds is not in the least required or in any way necessary." It is very kind of Mr. Fryer to state that he has "nothing to say against voicing the reeds, only that it is an art in which very few excel"; and very noble of him to confess that, although he can voice reeds to a certain extent, he can rarely or ever do it to his own satisfaction. But Mr. Fryer has misunderstood my remark that he imagined the shape and position of the tubes necessitated voicing; for, of course, if he spoke from experience, how could I know anything about it when I only spoke from a knowledge of what has been done in the trade since the American organ was born, and had (unfortunately, still have) no knowledge of the wonderful discovery of Mr. Fryer? That gentleman objects to my citing the orchestral organ as a proof that the shape and position of the tubes do not necessitate voicing, but that voicing (in the American fashion) is purely supplementary; and he objects on the ground that it is really a harmonium, whereas his remarks apply only to instruments constructed on the suction principle. Just pausing to note that the only difference of importance is the difference in the pressure of the wind, I may point out that I selected the orchestral organ for this reason: that its European cousin is made by one of the most accomplished reed organ builders in the world, who has done all that can be done for it in the matter of shape and position of tubes or channels, and has made it the first harmonium *par excellence*. Now the Americans have taken that instrument, and by their system of voicing have improved it; hence, as I said before, voicing the reeds is the primary consideration, the position of the tubes and their size have only a secondary effect, and so I must continue to believe until Mr. Fryer tells us how he manages to get characteristic tone. He is "prepared to say" that he has actually tried the experiment (p. 14), and being "prepared" to do all that, he might go a little further and tell us how he does it. Mr. Fryer "maintains" that when "all the tubes are made to one scale it does not influence the tone." I am not quite clear what the "it" means, or what Mr. Fryer "maintains," and how he does it; but on p. 21 I see he recommends "G Minor" to build his instrument on the suction principle, and get his tube-boards with reeds unvoiced, knowing, presumably, that the three tube-boards which "G Minor" is to get will have "all the tubes made to one scale" in their respective registers, unless he (Mr. Fryer) will tell "G Minor" what size he ought to obtain. I believe the American manufacturers will make the tubes any size, and stick them where you like on the soundboard. I may first mention, as Mr.

Fryer seems in a bit of a fog here, that "row," as applied to a tubeboard, will be understood to mean five octaves, unless some other number is specially mentioned. But what can be meant by the recommendation to get the boards with unvoiced reeds, when it is stated elsewhere that the tubes being all of the same scale will necessitate the voicing of the reeds? Why not state what size they should be to obtain the characteristic tone without voicing? Surely Mr. Fryer is not going to patent his secret? I begin to think that, with Mr. Fryer's aid, a very useful series of maxims for reed organ builders might be put together, which could be hung up in the workshops for their edification and the wonderment of the apprentices. On p. 14, for instance, Mr. Fryer says:—"Voicing the reeds does not affect the mechanical stops in any organ." How would something like this do? My "maxim" is not quite so profound as the other, but it is at least apposite and opposite.

MAXIMS FOR REED ORGAN BUILDERS.

By G. Fryer and N. E. Child.

Voicing the reeds does not affect the mechanical stops in any organ.	The size of the stop-knobs has no effect on the tone of the reeds.

I might add another maxim by Mr. Fryer which I find on p. 584, but I am not prepared just now with another on my side of the "table"; still, I must not deprive anyone of it. Steel reeds cannot be voiced, because, although steel will bend, it will spring back to its former position. That, be it noted, is the deliberate dictum of a man who, although not a reedmaker, has had "some years' experience in all kinds of reeds." I am sure that when the number of the ENGLISH MECHANIC for Sept. 7 reaches the United States there will be a rush for it, which will be followed by an absorbing anxiety to learn how Mr. Fryer obtains characteristic tone without voicing reeds. I hope he will give the information without delay. **N. E. Child.**

TRANSFER OF THOUGHT.

[21805.]—A GOOD deal has been written of late in the columns of this journal on the above subject. Permit me to give the result of some recent personal experience.

I was visiting last week some relations of mine at St. John's-wood, when the conversation turned on thought reading, or the transfer of thought, which is perhaps the better rendering. I had not given the matter any actual attention. I had read the letters which have appeared herein on the matter, as well as the correspondence in the *Times* between Mr. Bishop and Mr. Labouchere, in which I thought the latter had much the best of the argument; but beyond this I knew nothing. It seemed that some friends had been recently visiting at the house, who had given an exhibition of their power of thought reading, the explanation of which was attempted, but, owing possibly to personal density, I did not quite gather what was intended, and as the children of my relations had quite unexpectedly developed similar power, it was proposed to exhibit it for my benefit. I must premise that the family consists of the parents and four girls – Gertie, aged 18; Flossie, 16; Jennie, 12; and Jack (a pet name), 9; all as bright and merry children as ever gladdened a home. The experiments were as follows:—

Flossie was blindfolded and sent out of the room, and when the door was shut, I was asked to indicate something she was to do on her return. I said in a whisper, "Let her take an envelope (which chanced to be lying on the mantelpiece) and give it to me." She was then called in, and without a word being spoken, Gertie and her mother stood on each side of her, with their hands lightly pressed on each shoulder. The child soon made a forward movement down the room, and feeling for the mantelpiece, ran her hand along it till she found the envelope, felt till she found me, and put it into my hand.

The next to be sent out was Jennie, and in the same manner I again proposed that she should select from a pile of coppers *the last penny*, and give it to me. She was brought in as before, the same persons in contact with her, and in perfect silence she felt her way down the table, passing her hand over it till she found the money, then she lifted the whole, and selected *the last penny*, and gave it to me.

The next was Jack. I proposed, as before, that a thimble, with which one of them had been working, should be put into a little box, from which she was to take it and put it on a tray near by. This time, her two sisters, Gertie and Flossie, were sponsors. The child felt her way as the other had done, took up several things on the table, and put them down, till she came to the box, which she opened without hesitation, took out the thimble, put it on each of her fingers in succession, seemingly not satisfied, and finally deposited it on the tray. This was not a little marvellous, because the child could have had no personal consciousness that the thimble was in the box, having been placed there in her absence, and it would have been more in accordance with the ordinary fitness of things had she kept it on her finger. I asked her afterwards why she did not do so, she said "it did not feel right."

The next experiment was very interesting. Flossie was again sent out, and I suggested that she should remove the brooch her mother was wearing, and fasten it on the sleeve of the coat of her father, who was sitting in another part of the room: but we changed this and made that it should be fastened on one of the fronts. This time Gertie and myself were the sponsors, as I call them. The child came in as before, hesitating for some moments before she moved; then felt her way till she found her mother. She first took out her earrings, but at once replaced them and felt for the brooch, which she unfastened; then felt around till she found her father, and here she hesitated some time. She put the brooch in his hand but at once removed it; then on the sleeve of the coat, hesitated again, whispered to herself "it doesn't seem right," and finally pinned it on the coat at the place agreed upon.

Lastly, Jennie again went out, and I proposed to take off my watch and place it in a writing desk which stood on a sideboard, from which she was to remove it and give it to her mother. I and Gertie were sponsors as before. The child came in and, instead of going to the table as usual, felt around the room till she found the desk, which she opened, took out some things in the pen tray, replaced them, hesitated, closed the desk, went away, but came back; and this time she lifted the lid, took out the watch and carried it to her mother as agreed.

I have no explanation to give of these things, and they will probably read less strange than they appeared in the doing. I need scarcely say that collusion is out of the question. It has of late been made a family amusement, and to suppose that they would dupe each other, even if it were possible, would be absurd. I proposed in all cases what should be done when the child was out of the room, and not a word was said after her return. There was something almost uncanny in watching the blindfolded child groping her way in perfect silence and slowly but certainly doing what had been agreed upon. It seemed to me that each, like a pythoness of old, had their own volition suspended to become the impassive medium of a power external to themselves. It is only the three younger children who possess it, the eldest and the mother (the father will have no hand in it) can do nothing, and I was equally unsuccessful. I think the explanation is to be found in what I may call the greater passivity of children; their own wills are more easily put into perfect obeyance, and they follow blindly the prompting of their minds; while with older people an unconscious autagonism seems to be set up, which is fatal to success. It is necessary for the person whose hands are in contact with the medium to think very strongly of the object to be attained, and it is much more exhaustive to them than to the other. As I said before, I have no explanation to offer, but that thought can be transferred in the manner I have indicated is to me an absolute certainty, and I think, had the most sceptical of your readers seen what I did, they would be equally assured.

F. H. Carter.

13, Berkeley Villas, Wood Vale, Forest Hill.

[21806.]—BY some oversight I left out part of my letter 21779, p. 15, so that I now complete the remarks I intended to make on what was said by "F. W. H.," 21747, p 602.

In what I said I carefully left the particular point open on which his difficulty was founded, viz., the question whether there is in man an inner spiritual agent distinct from the material organs. But as Mr. Grey, 21778, p. 15, while speaking directly only as to so-called spiritualistic experiments may leave the impression that the belief in spiritual existence rather implies the want of being "advanced enough to follow the great German scientists," I will say that the very opposite is really the case. For myself I recognise the truth of all they say as long as they remain within the proper limits of *science*, that is of what is to *be known*. But when they pass from science into negative metaphysics, the great German or any other scientists are no better guides than any other people who talk about what they know nothing about.

As long as they follow out the operations of physical organs, and the probable mode of development of those organs and the evolution of the animal beings (including man) to whom the organs belong, they are in their rights, and I will and do go with them; but when they try to limit life and thought to these organs, and deny the existence of anything beyond them, it is they who are not "advanced" enough to comprehend truths too subtle for them.

It is like the presumptuousness of children when the anatomist denies the existence of some higher principle, because he cannot find it when dissecting the organs which alone are at his disposal, while yet he cannot offer the smallest explanation of the living action of those organs by anything his scalpel can reveal. That is *not science*; it can only be classed with other sayings which a writer of old very justly attributed to "the fool." To investigate the operations of nature and fail to see that those operations indicate *thought* and *will*, and that whether in nature as a whole, or in man as a part of nature, these faculties and that of consciousness involve a something inconceivable as belonging to the constantly changing atoms of which the body is constituted, is no sign of "advancement."

It is true that not only do the unquestionable facts exhibited in mesmerism very strongly support the belief entertained by the highest minds of all the ages, in an agent distinct from the bodily organs though operating through them, but the subject of transfer of thought is not necessarily limited to such an agency.

It is perfectly well known that every act of thought involves a physical action of the material brain. Its motions during thought can be felt and have been seen. Thought is accompanied by a development of heat in the brain, as also may be felt, and a concentration of nervous energy there which often makes the rest of the body cold. Now all this means a consumption of matter and a transfer of energy. Whether we hold with the materialist that these actions are themselves the agent, or with the spiritualists that they are the operations of an inner agent, the material facts are the same. It is no more improbable that such actions may *induce* some corresponding motions in another brain, and there develop the same thought, than that a motion of electricity or of magnetism should *induce* a similar motion in other electric or magnetic bodies. No man knows what the nervous agent is, but we well know that, while it is certainly not electricity, it is something having many analogies to electricity; and, therefore, there is an *à priori* probability of similar inductive actions existing.

But, after all, the consideration of what bearing the transfer of thought may have upon materialistic or spiritualistic conceptions of man's existence is absolutely out of place; it ought to have no effect upon any reasonable mind, because the one thing to be asked in this, as in all other cases, is, What is the truth? Does the fact occur? This settled, we may reason from the ascertained fact in any direction; but no supposed consequences ought to enter into this preliminary examination. **Sigma.**

[21807.]—REPLYING to my letter (21666), wherein I deny the possibility of a man seeing without eyes, "Sigma" says that "any intelligent doctor will tell me that we do not see with our eyes at all." In "Sigma's" last communication (21779) he informs us that "if a cataract forms on the eye the man loses sight, though his brain and optic nerve remain perfect." Comment is unnecessary.

T. E. D. Craven.

[21808.]—I ADMIT Mr. W. J. Grey's theory of a material connection being established between two brains in a natural way as perfectly possible, although the "how" may be unknown at present.

I also agree with "Sigma" that a "faith" not founded on scientific or so called "material" evidence, cannot be destroyed by any amount of such evidence. Neither did I desire myself to attack such "faith." All I wished to point out to your readers is that if what is now called soul, mind, or thought in man is merely the resultant of the molecular action of the brain, like "go" in a watch is the resultant of the machinery in motion in such watch, it appears to me impossible to treat "soul" or "go" as a "transferable" entity.

The view now taken by Büchner, Haeckel, and other scientists on production of evidence, the scientific value of which seems to me undoubted, does not question the existence of this "essence," but looks upon it no longer as an "agent" working with "tools," &c., but as the "product" or resultant of "brain" in motion in man.

F. W. H.

P.S.—Moleschott says: "Thought is a motion of matter."

CLARK'S IMPROVED DIAMOND HIVE.

[21809.]—I HAVE taken the *British Bee Journal* for years, and was struck by the likeness of the above-named hive to one that appeared in the *British Bee Journal* under the name of the "Anglo-Cyprian Hive," T. B. Blow, Welwyn, Herts, inventor, May 1st, 1883. In the *B. B. J.* of June 15th, 1883, the following appeared: "Why, friend Blow, somewhere fifteen years ago exactly that beehive was invented and patented in the United States by a well-known bee culturist (Dr. U. S. Conklin, of Ohio). It was called the 'Diamond Hive.'" Under these circumstances, I should like to know who was the original inventor of this mighty "Diamond Hive"? Was it Homer? **Apis Mellifica.**

[21810.]—I BELIEVE this style of hive was first brought out in America in or about 1851, and found unsatisfactory and given up. The same idea has

[illegible]

[illegible] Mr. [illegible]

[illegible]

B H Thwaite.

[illegible] Mr. [illegible] Hopkins [illegible]

[illegible]

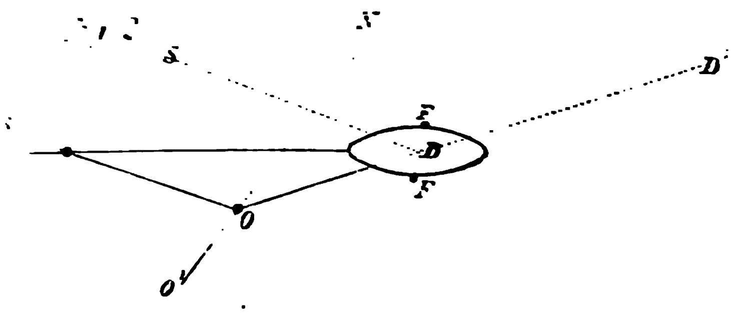
A Practical Printer.

THE THEORY AND CONSTRUCTION OF THE HELIOSTAT.

I.—Geometrical.

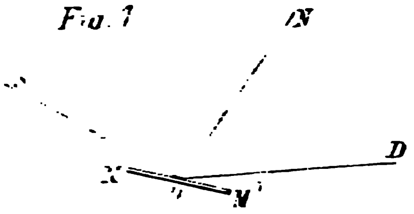
[illegible] heliostat may be defined as an [illegible] which the sun's rays may be re[illegible] [illegible] desired [illegible] direction being [illegible] throughout the time during [illegible] the earth.

[illegible] the several [illegible] by which this has been effected, it will be [illegible] the geometrical problem [illegible].



[illegible] Fig. 1 represent any point on the Earth's [illegible], O N the direction of the North Pole of the [illegible], O S the direction of the Sun, O D the [illegible] which it is desired that the reflected ray [illegible]. Let MM' be a plane mirror. Then the [illegible] condition is that, as the sun's direction [illegible] during the day, the mirror should be con[illegible] moved so that a normal to its surface [illegible] constantly lie in the plane S O D, and bisect the angle S O D. [illegible] that in the general case the motion of the mirror will be a complex one, no single [illegible] motion satisfying the problem: but a particular case may be noted—viz., when the desired direction of the reflected ray coincides with the polar axis of the heavens, or when O D lies on O N. Then, clearly, the motion of every point of the mirror will be a circular one about O N as an axis, and we obtain a solution of the problem for this particular case, by mounting the mirror on a stiff joint at the end of a rod pointing to the pole and causing this rod to revolve once in 24 hours. The mirror having been set in the morning so as to reflect the light in the direction O N, will thus continue to do so throughout the day. A second mirror may be fixed in the path of the reflected

Fig. 1



beam, and may be set to reflect the light further in any desired direction. Thus, with the aid of two mirrors, the problem is at once solved in all its generality, and this is by far the simplest construction. The first heliostat made was on this principle, and was constructed by Fahrenheit. As this construction is simple enough to bring it within the powers of every amateur to construct a serviceable instrument, we shall subsequently give full instructions for making it.

There are, however, manifest disadvantages in using two mirrors, and several solutions have been given by which the requisite complex motion may be imparted to one mirror only. Silbermann, Gambey, s'Gravesande, and others have all proposed solutions, and instruments have been constructed in accordance with them. The one we propose to describe is a slight modification of Gambey's, and is, on the whole, more simple and smoothly-working than the others. The geometrical principle upon which it rests will be understood from Fig. 2.

Let O D be a hollow rod containing within its bore the "handle" of a "fork" O F F' between the prongs F, F, of which the mirror M M' can turn freely on centres, after the fashion of a swing looking glass. Let D S be a rod fixed rigidly to the mirror, and in the plane of the mirror, and capable of sliding freely through a Hooke's joint at S, at the end of O S, a rod which can be clamped to the polar axis O O', and rotating with it so as to describe a cone about it, having its vertex at O. Let the hollow axis O D be fixed in space, and point in the desired direction of the reflected ray. Let O S be brought to point to the Sun, and then clamped to the revolving polar axis. It will be at once seen that the mirror will always reflect the light in the desired direction, provided O S = O D, D being supposed to be midway between the centres on which the mirror turns. The proof is very simple, and we may leave it to the reader, merely remarking that S O D being an isosceles triangle, S O and O D will make equal angles, with a perpendicular from O on S D, and that consequently S O, O D will make equal angles with the normal to the mirror: that is, they will be incident and reflected rays respectively. The fork F F', of course, secures the condition that the mirror should remain at right angles to the plane S O D or S D D.

In subsequent papers we will describe the practical construction of Fahrenheit's, and the modified Gambey's heliostats.

A. T. Hare.

(*To be continued.*)

THE PANAMA CANAL, &c.

[illegible]—So far as I have ever read or heard, the Panama Canal, by whatever route projected, will necessitate the construction of locks; the geographical conditions being, by any possible route, very different from those of the Suez Canal. If this is so, the idea of diverting the Gulf Stream is absurd. J. R. D.

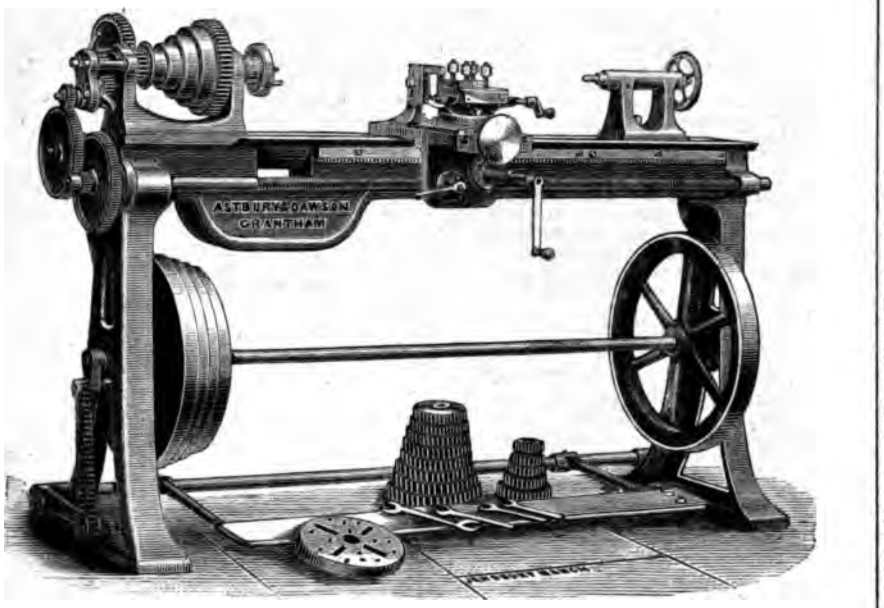
STANDARD 6in. SELF-ACTING FOOT-LATHE.

[21817.]—In your issue of Aug. 3rd, a passing notice appears of our exhibits at the recent Engineering Exhibition at the Agricultural Hall. Thinking that detailed particulars of one of our amateur lathes would interest your readers, we have pleasure in sending herewith an illustration and description of our standard 6in. screwcutting foot-lathe. For a future issue we will send illustrations of our set of amateur turning tools, noticed by "O. J. L."

The illustration represents our Standard 6in. Centre Amateur Foot-Lathe, with sliding and screw-cutting gear. This lathe has a gap bed 6ft. long, admitting 4ft. between the centres, whilst the gap will admit a piece of work up to 22in. diameter. The headstock is double geared, and fitted with conical bushes. These bushes are made of phosphor bronze, a material that gives very good results; steel bushes, however, are fitted when preferred. The bushes are brought to a true bearing for the mandrel, which is made of mild cast steel. The lathe shown has cone speeds for a flat strap, but a grooved cone for gut band is adopted if preferred. The ratio of the wheels and pinions forming the "head gearing," makes the headstock a very powerful one for surfacing, &c., without being heavy; the back gear is thrown out by an excentric. The headstock also carries a reversing motion, with wrought-iron cut pinions. The saddle, which carries a compound slide-rest arranged for surfacing, turning conical, &c., has long guiding surfaces, and is traversed by hand by rack and pinion. The guide screw is accurately cut in a Whitworth lathe to ¼in. pitch. Due attention has been given to the treadle motion, which has a very good action. The shaft revolves upon antifriction rollers, the crank being placed outside the standard as shown; a small antifriction wheel at the opposite end enters a groove in the shaft, effectually preventing endwise movement, with less friction than if a collar were used, and it constitutes a very neat arrangement. All the levers —including the crank—are keyed on with steel taper pins; this makes a good reliable job, set screws being unsatisfactory to a degree. All gearing is cast from machine-cut *iron* patterns, and the various screws, nuts, &c., are uniform sizes, and well fitted, all the *working* nuts are made of *steel* and hardened.

The lathe includes 22 change wheels, back stay, face plate, and a full set of screw keys.

Grantham. **Astbury and Dawson.**



KEY CHARACTERISTICS IN PIANO MUSIC.

[21818.]—Allow me to assure Capt. Cuttle that nothing he has said has so much as ruffled one of my feathers, and that what he has said in his letter on p. 14 does him great credit. The sole remaining difficulty will be easily explained if Capt. Cuttle will remember that in piano-playing—and with that only are we concerned—keys are not "pressed down," but struck; and it is only the "touch" of the performer that makes any difference in the force of the blow or the rapidity with which it is struck. An examination of the action ween the key and the string will show the effect of pressing as compared with striking. I shall be pleased if Capt. Cuttle will tell us what Prof. Stoney really did say, for if he puts the key characteristics down to what I should call defects in the keyboard, he is, as I believe, most certainly mistaken. **N. E. Child.**

OUR SPIRITUAL NATURE.

[21819.]—I have not had the advantage of reading any account of the researches or arguments of the scientists who are undermining spiritualism; but there is one view of the subject which has sometimes occurred to me to which I should like to call attention. "Sigma," in letter 21779, says the spiritual idea is independent of the material, and the loss of intelligence as the body wears out does not disprove the existence of the spirit. He then goes on to liken the spirit to a workman, and the body to his tools. Other correspondents have written in the same strain; and it would seem to follow that the faculties of the spirit become weaker in old age in consequence of the infirmities of a decaying body. But is that so? Is it not rather the spirit (assuming that we have a spirit independent of the body) which has its periods of rise, fulness, and decay? In youth the vital principle is strong and vigorous; in middle age it is robust; and then its powers become gradually impaired. So long as this vital principle continues active the body grows to its full stature, and (apart from disease and accident) retains its usefulness unimpaired. It is better at 30 than at 20, and there is no apparent reason why it should not be quite as good at 50 as at 30, and at 80 as at 50. Effete matters are constantly removed and worn out parts are changed. If the vitality which keeps it in good order for the first 30 or 40 years of life were to continue its efforts undiminished, why should the body wear out? It is true that in old age the eyes become dim and the muscles faint; but should not this feebleness of the organs be ascribed to the moribund condition of the governing spirit, rather than to the natural decay of the body itself, which is quite as subject to decay at 30 as at 80.

J. W., Birmingham.

THE GERMINATION OF WHEAT.

[21820.]—In making some experiments upon the germination of a fine sample of this year's wheat, I was surprised to observe that, within a week or ten days, each grain, as sown in ordinary garden mould in a flower-pot, outside a northern window, developed from the embryo quite a well-formed root or radicle, corresponding with the growth above of the plumule or young stem.

Now, as the albumen of the seed appeared to have been but little absorbed by the cotyledon of the young plant, I was naturally led to infer that the growth of the latter depended chiefly upon the pabulum which it derived through the radicle from the soil; and I, therefore, in order to test this conclusion, divided a few of the grains in halves transversely, and planted in a flower-pot as before those of the sections bearing the embryo, which, as most of your readers know, lies within a little oval depression at the narrowest end of the grain, that is easily detected, even with the unaided eye. As I had anticipated, all these half-seeds readily germinated, and, upon examination, the young roots appeared to have developed quite as fully as those of the perfect, undivided seeds, and within the same few days. The plumules, too, had correspondingly advanced in growth.

These phenomena in the case of wheat are, I think, not only interesting in a botanical point of view, but may also have a practical bearing upon the present costly operation of "sowing," which every agriculturist is naturally desirous, as far as possible, of economising. For, if a crop could be raised by sowing merely the *embryo halves* of the grains, and these halves could be readily made and separated by machinery or by hand; it is evident that the other, or, as it may be called, *infertile* half of the seed might be thus saved and, like the whole wheat, converted into flour.

I hope that these imperfect observations may give rise to further experiments in what may not, I think, be inappositely termed a *new field* of culture.

Stoke Newington. **W. H. O.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[50746.]—**American Organ.**—Under the head of "Steel Reeds," p. 20, Mr. Scott replies to some remarks made on p. 580, by asking why, if the "bending," &c., does so much good, it is not applied to the bass notes? which he is sure want it as much as, if not more than, the upper notes. The simple and sufficient answer to this question is that the "bending," &c., *are* applied to the bass notes, even to the large sub.-bass reeds, in a genuine American organ. After that, I must begin to fancy it is a harmonium or an Anglo-American sham that your correspondent refers to; for certainly if he draws, say, the 8ft. C. of a genuine American organ, he will find that just as much care has been devoted to bending and twisting it as has been given to mid C.—Organon.

[50765.]—**The United States.**—"Num Dor," in his communication under the above head, asks me for further information concerning Dakota. He has heard a good deal about hurricanes and cyclones in the western parts of the United States, and somehow he has come to associate these severe visitants with this favoured region. It is not a fact, as he is inclined to assume, that "one's crops are liable to be destroyed at any hour," and men do not "think themselves lucky if they are able at times to hold on to a post that is not blown out of the ground." In reply to my correspondent's questions I would say that houses are not "lifted bodily up and carried miles away" in North Dakota; trains are not overturned and cornfields are not "cut as neatly as if the reaper had been over them." Really these stories are very strange to the people of North Dakota. "Nun. Dor." should remember that this country is full of men whose occupation it is to get up big gooseberry and big cyclone stories, and much that they write in fun is taken seriously. I am not prepared to defend this sort of writing, but the writers exist, and the fact has to be faced. There is another point to be remembered. In England a house is a brick and stone edifice which would require a very powerful wind to lift it up bodily. In the United States a house is liable to be of a very different material. In Mandan, for example, and in fact in some cities of 100,000 inhabitants, a majority of the houses are of lumber, and it needs a visit to this country to convince a foreigner that a wooden house can be made as comfortable, if not more so, than one of brick. Some roads are "impassable for loads" in Dakota, perhaps, but so far we of the west Missouri country do not suffer any great inconvenience from this. The railroad is the great load carrier in this part of the world and trains always run. My querist is troubled over a statement which he has met with to the effect that "the days are long—there was a day in June when scarcely an hour of the 24 was really dark." I never saw such a statement before regarding North Dakota. The days in the summer time are not as long here as they are in Edinburgh, Scotland, nor are they as short in the winter time. The question for immigrants is, "what is the probable length of their days," says "Nun Dor." This is a very practical question. Some emigrants have been here five or six years. It would be difficult to find a steady man who has been here that time who is not highly prosperous. Others have been here shorter times, and they also are accumulating wealth with more or less rapidity. The fact that no one wants to go back east to live after having spent some time in this glorious northwest is a great recommendation to it. The only poor men around here—poor in the English sense—are those whose habits or tempers or dispositions are such as prevent them from acquiring money.—R. M. Tuttle, Mandan, Dakota, U.S.A.

[51114.]—**Power of Engine.**—The ordinary way of ascertaining the h.p. of an engine is to

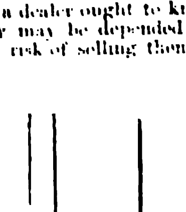
[illegible]

[illegible] —**Legal. Stepchildren.**—[illegible] his wife. The children's [illegible] —Lex.

[illegible] —**Legal – Secretary's Liability.**—Yes, secretary would be [illegible] holding possession.—Lex.

[51466.] —**Squinting.**—[illegible] with a shell [illegible] in the centre, in such a manner that the patient will be compelled to look through the [illegible] does not produce any effect in a week or two the effort to look through the hole will stretch the muscle "turning" the eye, take the [illegible] surgeon, who will, if he thinks it necessary, perform a very simple operation [illegible] he will think in [illegible] that above described [illegible] not advise without seeing the patient.—[illegible]

[51274.] —**Overstrained Piano.**—[illegible] or Mr Davies.—[illegible] could not have improved upon the advice given by "J. C. L.", but the [illegible] query was too [illegible] strongly reminded me of the kind of piano of which a maker would say at the first glance, "A new inside is evidently necessary, and as the case is somewhat old-fashioned, it would be better to renew that as well." This seems an extravagant picture; but I can assure "J. C. L." that I have now in my showroom a piano that I bought for £5—that is to say, it represents the piano, but it has been, piece by piece, renewed, until the carved legs and the metal plate are the only original portions left, and it was nothing but a vivid recollection of the trouble and expense entailed upon me that caused me to give the advice I did. "J. C. L." with his Cramer pianette, is not likely to, and I hope he never may, know what "trouble" of this kind is. I do not suppose that a "Puzzled Pianist's" friend is the only one, by a great many, who has made a pilgrimage in search of "Scott and Co. (from Collard and Collard)," and it may be of service to others of our readers to know that the name is fictitious, and together with such names as Tomkinson, Stoddart, Delamere, and, later on, with others of a more German sound, such as Steinmann, &c. (the most of them being only colourable imitations of well known firms), is not put upon pianos without good and sufficient reason. I do not go so far as to say that, because a name is fictitious, the piano is necessarily worthless, since many makers are in the habit of using copyright titles other than their own trade mark for their lower-priced pianos, but, though such pianos are not warranted, a dealer ought to know pretty well how much they may be depended on, and, if he [illegible] to take the risk of selling them, is responsible



[illegible] standing [illegible] well. A "Puzzled Pianist" does not, however, say that he purchased from a dealer, so I suppose he bought it at a sale, or possibly, from "a family leaving town." In either case he would be absolutely without redress. The question whether such a piano is worth the trouble and expense of repairing seems now more doubtful than before; but since he seems wishful to try his hand, I shall be glad to help him all I can. I do not know how the "Harmonious Blacksmith" proposed to apply an iron bracing at the head of the strings, but probably he intended it as merely an auxiliary support; but in this instance it would be wholly insufficient, since it would have to bear the whole of the strain, and there would not be enough room between the [illegible] and the strings to make it of sufficient strength. I should rather advise your correspondent

[illegible] between the [illegible] the plank. In the first [illegible] strings [illegible] the wrest-plank. [illegible] the plank may [illegible] The wood must then be [illegible] making of the plank when the strings are tightened. The stays [illegible] will be a better [illegible] of screws, as [illegible] will serve for a [illegible] itself when the pressure is taken off [illegible] it may be straightened by damping and pressure [illegible] When all is complete, I should not risk taking the strings up [illegible] at least, until it is seen how it [illegible] They may be made of deal, but [illegible] and varnished [illegible] of service. I shall be glad [illegible] by post.—W. H. Davies.

[illegible] —**Paint.**—I think the [illegible] will find something suitable in water glass.—Nov. Dun.

[illegible] —**Keeping Polyzoa.**—If you have failed to keep these alive, it must be because there is something wrong with the aquarium. [illegible] water from the [illegible], and have your plants in good condition. They ought to live for some time then.—[illegible] E. M.

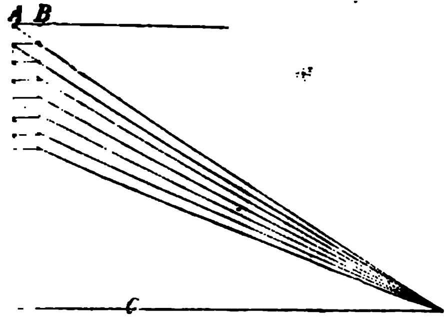
[illegible] —**Coal Mines.**—The statement is not correct now, if it ever was.—Durham.

[illegible] —**Cylinder, Largest.**—In Vol. XIV., [illegible], it is stated that the largest cylinder for a pumping engine is believed to be at the Lehigh [illegible] mines, Pennsylvania. The diameter is [illegible], and the stroke [illegible]ft. There must, I should think, be some larger than that; and the Lynden engine, for draining the Haarlemmer mere, has a cylinder 12ft. in diameter, with an inner cylinder of 7ft.; but I do not know length of stroke.—T. P.

[51313.] —**Forging Hard Steel.**—The published directions for treating "R. Mushet's Special Steel," issued by the makers, Samuel Osborn and Co., of the Clyde Steel and Iron Works, Sheffield, are as follows:—This steel should be worked at fully the same heat as ordinary lathe-tool steel. It should be heated gradually but thoroughly, so as to be quite ductile under the hammer, and the tool should be forged and finished off at a good heat. Avoid forging it too cold. When forged and shaped, the tool should be laid down to cool; and the cooling must not be hastened by dipping in water. Heat the steel before cutting it into lengths, as it cannot be nicked when cold. If smiths will attend to these instructions, they will have less trouble and waste than with ordinary cast steel.—A. P. S.

[51346.] —**Clarionet.**—In reply to "Old Blowhard's" remarks on p. 19, when I said that the bell mouth on the end of a clarionet increased its loudness, I meant to have said "its timbre." I have just tried this instrument with and without the bell mouth, upon a listener in the next room, who preferred the tone without the bell. I am only in the stage referred to by "O." (see 51432, p. 20), and have no doubt that the neighbours would gladly assist at my funeral. I do not find that removing the bell "sharpens the pitch" of any note whatever. The diameter of bore given as $\frac{5}{16}$ is either a mistake of the printer, or my own, as it should read $\frac{9}{16}$; also the name of the maker should read, Button and Co., London. I am of opinion, so far, that a better tone can be obtained from larger bored instruments, and am experimenting in this direction. As regards the beech reeds, I find that they become soft if kept long in the mouth, but are useful for a beginner to pare away at, until he learns the art of voicing, as I could not run that scale with a reed fixed by "The Man in the Music Shop." For purity of tone, the Spanish cane is unapproachable.—A., Liverpool.

[51346.] —**Clarionet.**—I regret that, as I am from home at present, I cannot answer the queries of "J. J. D." for a fortnight; also, I am rather in doubt as to which kind of clarionet he wants to make, but I presume it will be the Albert model. As to the scale of distance, it can be got in a variety of ways; the simplest is by drawing. Make two perpendicular lines 24in. long, 2in. apart; then at the foot of these draw a longitudinal line 36in. long; from the end of this last line draw a line to the top of the first 24in. line, and then at the point that this angular line crosses the second 24in. line, draw a parallel line. I inclose a rough sketch. A B are the 24in. lines, 2in. apart; C is the 36in. line. The small parallel lines are the divided scale. By proceeding thus you can get the proper distances for sounding tubes or strings, and by varying the distance apart of the 24in. lines any distance can be so divided. The other way is more correct, and consists in dividing the total distance into 1000 parts, and then measuring off the distance of each note from the end of the scale. These distances I will send to "J. J. D." when I get home. As to the bore of clarionets, the best bore for B flat clarionet is 15 millimetres, or $\frac{6}{10}$ths of an inch. As to the others, it is a matter of opinion entirely: each maker having his own idea on this subject. But the bore required can be easily calculated from the B flat bore, and taking the B flat bass clarionet at 22 millimetres; any clarionet can thus be given its best size. As to the question of notes, it would require too much space to make this clear: but if there is sufficient interest taken by the readers of the "E. M.," I will endeavour to give a short article on the subject of "Tubes with Sounding Holes." Meantime I refer "J. J. D." to "Böhm on the Flute," translated by W. S. Broadwood, published by Rudall, Carte and Co., price about 2s. 6d. As to the latter part of query—viz., kind of brass, I don't understand it, as there is no brass about a clarionet, not even in the tone! As to the measurements given by "A., Liverpool," they are quite extraordinary, as I never saw yet a clarionet with as small a bore as $\frac{5}{16}$ths of an inch. Again, the "reed centre" is very indefinite; and spruce timber is certainly not a good material, either for tone or workmanship. I think when one goes to the trouble of making a clarionet, it must be done thoroughly, and not merely a toy product, which is no credit to the maker.—Vulcanite.



[51357.] —**Faraday.**—You couldn't have a better book than "Faraday as a Discoverer," by Prof. Tyndall (published by Longmans, Green, and Co.)—R. A. R. Bennett.

[51362.] —**Legal—Advertising Lotion.**—No person can by law sell any poison but a duly registered chemist and druggist, under a penalty of £5, or a legally-qualified apothecary or member of the Royal Hospital for Veterinary Surgeons of Great Britain.—Lex.

[51387.] —**Legal—Agreement.**—A contract not under seal may be waived or abandoned by word of mouth only, even, it would seem, if it was one which the law requires should be in writing; but in the latter event it would best be done by some writing.—Lex.

[51415.] —**Legal—Unfulfilled Lease.**—I do not see what you can threaten the farmer with. If he has made a fortune, there can be no probability of his being a bankrupt; but if he is made one, or neglects to pay the rent, or makes any breach under the covenants of the lease, you have your right of re-entry, and for any rent due at the time of his bankruptcy you could recover. The trustees under the bankruptcy would have all the powers to sell or disclaim the lease for the benefit of his creditors. In fact, I think you should not be too hard, but let him or his son have a lease at what you know is the proper amount of present rent, and save all annoyance and costs of any forfeiture or bankruptcy; and although it would be at a reduced amount, I consider you would be the gainer in the end, and close all contention and litigation.—Lex.

[51424.] —**Electric Time Ball.**—The ball may be raised by a line passing over a pulley in the top of the pole on which the ball slides. This line is wound on a barrel which has another line carrying a counterweight wound on it; a buffer spring is also placed at the bottom of the pole for the ball to fall on. The barrel is held, when the ball is up, by a lever which rests on a trigger. When the circuit is completed, the electro-magnet attracts the trigger, and allows the lever to fall, releasing the barrel, and the ball slides down the pole. I will give you a sketch of the apparatus, if necessary.—W. Baldwin, 110, Richmond-road, Dalston.

[51432.]—**Clarionet or Oboe.**—To "O."—Will you kindly state whence and how the reed in its unworked state is to be procured?—so as to be sure of the time it was cut during its growth; for instance, whether of last year's or this year's growth. Older reeds are too brittle, and never can give the desirable soft tone for drawing-room.—P.

[51432.]—**Clarionet or Oboe.**—Would "O." (page 20), or someone else who knows all about oboes, inform me whether oboe playing is injurious to the health in any way? I have heard it said that it was the oboe that killed Barrey (a great oboeist) and one or two others. They say the inevitable fault is chiefly due to the reed, and the bore that is connected with it having such a small aperture, thus preventing a proper amount of breath to pass from the lungs, and so causing a severe pain to be felt across the chest if played for any considerable length of time. Would "O.," or any other kind reader, inform me whether there is any foundation for this statement. Also the time it would take a person to master the reed sufficiently to be able to play moderately easy music.—E. T. S.

[51445.]—**Legal—Building Society Mortgage.**—Your name is perfectly good on the deeds and mortgage, and the house would be your separate property under the Married Women's Property Act, 1870, sect. 5; but to secure it from going to your husband on your death, you must make a will. This can be done, notwithstanding the mortgage may not be paid off, or else it would go to the husband only. You must, during your lifetime, keep up your instalments, and your successor must do so in the event of your death.—Lex.

[51464.]—**Legal—Medical Electrician.**—B. cannot prevent A. from publishing his own testimonials. A. should prevent B. by giving notice in the local newspapers; and if he continues after that, get an injunction from one of the courts.—Lex.

[51493.]—**Laundry Stove.**—If "Economist" will advertise his address, I may be able to put him right.—Vulcan.

[51494.]—**Lime Juice.**—Try one pint expressed juice, one pint water, and 3½lb. best lump sugar; warm till the sugar has dissolved, and strain through a jelly bag.—Fred.

[51497.]—**Small Brace.**—Thanks to "W. E. G." and others, but it is not the "Archimedean" brace I am meaning, as I have had one of these; but one worked simply by the hand. Of course the Archimedean requires the breast or other power for pressure.—E. Owen.

[51500.]—**Mathematics.**—The way to find the cubical content of the two heaps of stones is as follows:—To the sum of the areas of the two ends add the square root of the product; multiply this sum by the perpendicular height, and one-third of the product is the solid content. First heap, $110 + 25 + \sqrt{(200 \times 25)} \times 5 \div 3 = 135 + 52{\cdot}4 \times 5 \div 3 = 312{\cdot}3$ cub. ft. Second heap, $200 + 75 + \sqrt{(200 \times 75)} \times 5 \div 3 = 275 + 122{\cdot}4 \times 5 \div 3 = 662{\cdot}3$ cub. ft.—G. Worland.

[51500.]—**Mathematics.**—Supposing

x = sq. feet area of base
y = do. of top
z = do. of midway horizontal section
and h = vertical height in feet.

According to Nesbit's "Mensuration"—

$$\frac{x + y + z \times 5}{6}, \text{ giving cubic contents.}$$

1st heap contains—

$$\frac{110 + 25 + 240 \times 5}{6} = 312{\cdot}5 \text{ cub. ft.}$$

and 2nd—

$$\frac{200 + 75 + 525 \times 5}{6} = 666\tfrac{2}{3} \text{ do.}$$

—Buttershaw, Sept. 8.

[51500.]—**Mathematics.**—Contents of heap No. 1 = 312½ft. cube; contents of heap No. 2 = 666⅔ft. cube. Rule (as given by Rankine).—To the areas of the top and bottom add 4 times the area of a cross section midway between and parallel to the top and bottom, divide the sum by 6 for the mean section, and multiply by the perpendicular height. This may be proved by calculating the heap as being made up of the centre square and the wedge-shaped sides and corners. It will be seen that the above answers differ from those given in last number, and by the following example it is shown that the methods employed in the three first replies are wrong. Thus, required contents of a heap 6ft. by 6ft. on base, 2ft. by 2ft. on top, and 4ft. high.

$$\left.\begin{array}{r} 6 \times 6 = 36 \\ 2 \times 2 = 4 \\ 4 \times 4 \times 4 = 64 \end{array}\right\} = 104 \div 6 = 17\tfrac{1}{3} \times 4 = 69\tfrac{1}{3}.$$

Answer, 69⅓ft. cube.

Now, by the method shown by "Salvo Jure," "G. H. F.," and Evans, the above heap would contain 80ft. cube. According to A. McCormack, it would contain the proper amount, 69⅓; but by his method it is necessary to extract the square root of a number, which trouble is saved by the rule given above.—Ditton.

[51500.]—**Mathematics.**—The three correspondents who send answers to these questions will find, on consideration, that their solutions are incorrect. The only elementary method of solution consists in dividing the irregular solids into 9, more regular figures by 4 vertical planes, each containing one edge of the upper surface. These four planes will divide the figure into a central prism, four rectangular wedges, one on each side of the prism, and four pyramids, one at each corner. Thus, in question (1), with base 10 × 11, top 5 × 5, and height 5ft., we shall have prism, of which ends are 5 × 5, and height 5 = 125. Two wedges will be each 5 × 2½ × 5 high; the other two 5 × 3 × 5 high. The volume of a wedge being half of the corresponding prism, we have volume of first two wedges = 5 × 2½ × 5 = 62½, volume of second couple = 5 × 3 × 5 = 75. The pyramids at the corner will have bases measuring 3 × 2½, and their volume is found by taking ⅓ of height by base, or $3 \times 2\frac{1}{2} \times \frac{5}{3} = 12\frac{1}{2}$. There are four such pyramids.

$$\therefore \text{ Volume of pyramids} = 50.$$

$$\text{Total volume} \left\{\begin{array}{lr} \text{Prism} & 125 \\ \text{Wedges} & 137\frac{1}{2} \\ \text{Pyramids} & 50 \end{array}\right.$$

$$\underline{\overline{312\tfrac{1}{2}}} \text{ Ans.}$$

Similarly for the second question—

$$\begin{array}{lrcl} \text{Base } 20 \times 10, \text{ top } 15 \times 5, \text{ height } 5 & & & \\ \text{Prism} & 15 \times 5 \times 5 & = & 375 \\ \text{Wedges} & 15 \times 2\frac{1}{2} \times 5 & = & 187\frac{1}{2} \\ \text{Wedges} & 5 \times 2\frac{1}{2} \times 5 & = & 62\frac{1}{2} \\ \text{Pyramids} & 2\frac{1}{2} \times 2\frac{1}{2} \times \frac{5}{3} \times 4 & = & 41\frac{2}{3} \\ \hline & & & 666\frac{2}{3} \end{array}$$

The above results may be checked by estimating volume by integral calculus.
For question (1), one slant side increases from 5 to 10, and the other from 5 to 11.

$\therefore$ At a distance x below the top we have for the length and breadth of the rectangle $\left(5 + \frac{6x}{5}\right)$ and $(5 + x)$.

$$\therefore \text{ Area of rectangle} = \left(5 + \frac{6x}{5}\right)(5 + x) = 25 + 11x + \frac{6x^2}{5}.$$

$$\therefore \text{ Volume of small element of thickness } dx \left(= 25 + 11x + \frac{6x^2}{5}.\right) dx$$

$$\therefore \text{ Volume} = \int_0^5 \left(25 + 11x + \frac{6x^2}{5}\right) dx.$$

$$\text{Now } \int \left(25 + 11x + \frac{6x^2}{5}\right) dx = 25x + \frac{11x^2}{2} + \frac{2x^3}{5}.$$

$\therefore$ Volume = 125 + 137½ + 50 = 312½ Ans.; and similarly for the other one.—John F. Wilkinson, A.R.S.M.

[51502.]—**Small Dynamo.**—If "A Would-be Dynamo Maker" and Mr. Sutton will advertise their addresses I shall be very pleased to send them a description of my machine on my return home, which will be in a few weeks.—W. P. A.

[51503.]—**Legal—Will.**—The will should be proved by the personal representative of such deceased executor. The widow is not bound to do so; but she may take out letters of administration if executors renounce. Why not get the eldest son of the deceased brother to do so?—Lex.

[51504.]—**Colouring Photos.**—Have you tried the old-fashioned plan of licking the photo. with your tongue? Not very pleasant, perhaps, if the photo. is large; but there is nothing better that I know of, unless oil colours would suit you.—W. Robinson, Jun.

[51508.]—**Wet Plates.**—Your bath is evidently contaminated with organic matter of some kind, and you cannot do better than expose it to strong sunlight until clear; then filter and try again. I do not know what Foulke's cement is composed of; but if you use shellac for cementing your dipper, you will be all right. It is not by any means absolutely necessary to protect the collodion and bath from light when not actually in use; but the latter should certainly be closely covered, to keep out dust, flies, &c.; hence it is the general practice to keep it in a case or box of some kind. If you should still be troubled with the spots, describe them more particularly, as there are spots and spots.—W. Robinson, Jun.

[51509.]—**Rabbits.**—I have put rabbits to breed at four months old; but six months is a better age, as the young are stronger. There is a good book published by Routledge and Sons, at 1s., called "Pigeons and Rabbits," by E. O. Delamer.—Ouest.

[51513.]—**Architectural Photography.**—Ross's triplet, or Tench's planographic, would probably answer your purpose as well as any other; supposing them to be in good order and condition, and not defective in any way; and the exposure, using gelatine plates, would not be very long, unless the light were bad, or you were compelled to use a very small stop.—W. Robinson, Jun.

[51514.]—**Power of Engine.**—17 × 17 × ·7854 = 226·9806 area of piston, 2 × 150 = 300ft. piston travel, 226·9806 × 300 × 100 ÷ 33,000 = 206·3 h.p. with one cylinder. Multiply that by 2 gives 412·6 h.p. with two cylinders. The wheels have nothing to do with the answer.—H. W.

[51514.]—**Power of Engine.**—As the speed of piston is 150 × 4 = 600ft. per minute, and the effective pressure per sq. inch throughout stroke is 100lb. on piston, and the quotient of any steam-engine cylinder squared divided by 14 gives the indicated horse-power of that engine for piston speed 300ft. per minute, and pressure 10lb. per sq. in., inasmuch as $17^2 \div 14$, or $289 \div 14 = 20{\cdot}64$, so 17in. piston 10lb. pressure, 300ft. speed, gives 20·64 h.p., 17in. piston 100lb. pressure, 300ft. speed, gives 206·4 h.p., 17in. piston 100lb. pressure, 600ft. speed, gives 412·8 h.p.; for one cylinder or for two, speed gives 825·6 h.p. Another way.—As the cylinder's diameter squared gives the indicated horse-power of steam-engine whose piston speed is 420ft. per minute, and effective pressure per sq. inch, 100lb. per sq. inch. By double slide rule: Setting 420 on slide $\frac{B}{C}$ opposite 17 on line D, and 100 on slide N opposite 600 on slide $\frac{B}{C}$; then opposite 100 on slide N is nearly 413 h.p. on A for one cylinder as before.—Buttershaw, Sept 8.

[51514.]—**Power of Engine.**—Multiply the area of the cylinder in inches by the speed of piston in feet per minute, and this product by the pressure of steam in pounds. Divide the result by 33,000 = horse-power of one engine. To work this out in your case:—17 × 17 × ·7854 = 226·98, say, 227 (to clear the question of decimals) = area of cylinder. I presume you mean 150 *revolutions* per minute, if so, the speed of piston will be 2ft. × 2 × 150 = 600 speed of piston in feet per minute. Then—

$$\begin{array}{r} 227 \text{ Area of cylinder} \\ 600 \text{ Speed} \\ \hline 136200 \\ 100 \text{ Pressure} \\ 33{,}000)13620000(412\frac{3}{4} \\ 132000 \\ \hline 42000 \\ 33000 \\ \hline 90000 \\ 66000 \\ \hline 24000 \end{array}$$

$$\frac{24000}{33000} = \tfrac{3}{4}$$

That is 412¾-horse-power for one engine, or 412¾ × 2 = 825½ horse-power for the whole engine. If your correspondent or any other reader does not understand the use of decimals, here is a handy rule for finding the area without their use:—

$$\begin{array}{r} 17 \\ 17 \\ \hline 119 \\ 17 \\ \hline 2)289 \\ \hline 2)144\frac{1}{2} \\ 7)\ 72\frac{1}{4} \\ 10\frac{1}{4} \\ \hline 227 \end{array}$$

—Tyke.

[51518.]—**Paint for Brine Cistern.**—The best paint to stand the action of brine is an anti-corrosion paint, sold in London; but it is against the rules to give the address. If "Brine Spring" would advertise his address, I should be happy to inform him where he can purchase it.—Machina.

[51525.]—**Magnetism—Science Examination.**—I am much obliged to R. A. R. Bennett for his reply: but it lacks the information required. William John Grey evidently knows what is required. Permit me to say that it is not required which, when cold, just flows, having lost the gelatinous texture. In this liquid dissolve 8 parts of gum arabic, in lumps, adding a little water if needful; then add 4 parts of glycerine, and stir in well. Evaporate the water from the medium over hot water, and keep the medium in a covered vessel. It will not dry up. To make colours:—Take a quantity of dry colour in powder, by measure, and about the same quantity of the medium, and mix well together, using water, if needed, to assist the mixture. Some colours, usually the most costly, are fine enough as sold to be mixed at once with a palette-knife. Others, coarser, need grinding on a stone with a muller. Some colours require more medium, others less. The coarser colours, such as yellow ochre and Vandyke brown, the most. Gamboge requires very little. One part of medium to 4 of colour will do. For most colours equal quantities are about right. By this method colours can be home-made at a trifling cost fully equal to the best sold. Pans of the size for the usual water-colour boxes can be made of card, folded up and bound round with a pasted slip of paper.—Fisherman.

[51591.]—**Cigarette Machine.**—The secret in making cigarettes by hand is that you, when you are lapping the paper, pull with both hands as much as the paper will allow. Don't put too much tobacco in till you can make them well.—J. H. Schucht.

[51592.]—**Utilising Vegetable Fibres.**—I shall be glad to give inquirer full details of machines as largely used in Mauritius, and East and West Indies, and at the Cape, if he will advertise his address.—Jonson.

[51595.]—**Chinese White.**—Chinese white is oxide of zinc; it is prepared by grinding up the oxide with a mucilage of gum tragacanth to the required consistency, and then adding (for quantity to fill ordinary Chinese-white bottle) 12 drops of thick mucilage of gum arabic, and 6 drops of pure glycerine. Make the mucilage by putting a piece of the gum into a small quantity of water until it swells up and absorbs water, and then beat it into a pulp. When the colour gets dry, grind again with a little of the medium.—E. A. H.

[51596.]—**Platinum.**—No single acid acts on platinum, but nitro-hydrochloric easily dissolves it, so that if you are using it in a battery, see that your nitric acid is pure and free from hydrochloric. Caustic potash solution does not act on it, but at high temperatures caustic potash, potassium nitrate, and lithium hydroxide corrode it. Chlorine water also acts on it, and mixtures of chlorides and nitrates.—E. A. H.

[51596.]—**Platinum.**—Yes; caustic potash does act injuriously upon platinum when heated on a piece of it. A mixture of hydrochloric and nitric acids dissolves it entirely. Harcourt and Madan ("Practical Chemistry," page 7) say that the following substances ought never to be heated in a platinum crucible:—Substances evolving chlorine or sulphur, caustic alkalies or barium hydrate, cyanides, chlorates, nitrates, easily reducible metallic salts, or the corresponding metals—*e.g.*, lead, silver, or tin.—R. A. R. Bennett.

[51597.]—**Oxide of Copper.**—The simplest method to make oxide of copper is to heat the nitrate.—E. A. H.

[51597.]—**Oxide of Copper.**—On adding solution of potassic hydrate to solution of copper nitrate you will get a light blue precipitate; on boiling this precipitate it will turn black. This black precipitate is the copper oxide you require. Or if you want *red* copper oxide, dissolve some grape sugar in a little water (if the liquid is not clear, filter it), and add a few drops of copper nitrate. On adding potassic hydrate to this solution no precipitate will be produced, if the grape sugar is present in sufficient quantity. If any precipitate is produced, go on adding caustic potash, drop by drop, till the precipitate is dissolved. Now heat the mixture to boiling, and you will get a yellow precipitate, which immediately changes to a red one. This red precipitate is copper protoxide, or red oxide of copper.—R. A. R. Bennett.

[51600.]—**Chemical.**—Owing to the citric acid, which will not keep in solution. Try the addition of a drachm or so of glacial acetic acid.—W. Robinson, Jun.

[51600.]—**Chemical.**—I don't think it is possible to prevent the fungus from appearing, unless some other chemical was put in. Solution of tartaric acid behaves in the same way.—R. A. R. Bennett.

[51601.]—**Photographic.**—There is a book on Theoretical Photography" among the "Text-oks of Science," I think. I do not know the blisher's name.—A. T. P.

[51601.]—**Photographic.**—In Abney's "Trea-se on Photography" (one of Longmans' Science t Books) the subject is treated at much greater than in his "Instruction," and more in —Ditton.

[51601.]—**Photographic.**—Hardwich's Manual deals very fully with the theory of photography. Mine is an old copy, dealing chiefly with the wet process, but no doubt the new edition (see advt.) will be brought well up to date.—W. Robinson, Jun.

[51602.]—**Testing Piano.**—(1) Buy no piano which is less than 4ft. in height. Pianettes are only fit for schools for children to practise on. In a private house where there is good music expected, they will not answer on account of the bass strings being too short, therefore the bass produces an indistinct noise only. (2) See that there is an iron frame on which the strings are fastened; it will cost a little more, but then you are safe that the case will not collapse, and it will require less tuning. (3) See that it has a check-action. After the hammer has struck the strings the check holds it firm and ready for another blow. If there is no check the hammer is not in the power of the player, because it is dancing about. (4) See that the holes in the front of the keys are lined with cloth, as the bare wood working on the pins will make a rattling noise after being used for a time. (5) Raise the dampers and strike some chords, and see that the tone is sustained 45 seconds. Sustaining quality is the test for good quality. If the tone is short, it is evident that there is some interference somewhere, and that interference alters the quality of the tone also, but not for the better. (6) See that the pins (the tuning pins) are very tight, if they are not, the piano will not stand in tune.—J. H. Schucht.

[51606.]—**Repairing Engine.**—(1) Are you quite sure that there is no binding? for I have known a case where the engine could not be run at full speed through the piston rings being too tight. (2) The main valve may be a very large one; if so, a great deal of friction will be the consequence. (3) The packings of air-pump (if condensing) may be done: if so, a certain amount of power will be lost through a defective vacuum. (4) The piston may be bad, and allow steam to pass from one side to the other, and every pound of steam lost in this way will be equivalent to a loss of two pounds. If you could disconnect the shafting, and apply the indicator, and take a friction diagram, any of the above defects would be revealed. The first would be revealed by the average pressure of the diagram, which should not exceed 4lb. per square inch, if there be no excessive friction of working parts. (2) A large valve would also give a greater average pressure on diagram, but a proof of the great friction of a valve is the shake or vibration of valve rods. (3) If the cause is in the air-pump, it will plainly show on diagram, for the back-pressure line should be 12lb. below the atmospheric line, otherwise the vacuum will not be good. (4) If the piston is leaky, the pressure at the end of the stroke will be higher than that due to expansion, and will be shown by the back-pressure line rising. There are many other causes which may exist, such as the opening and closing too soon, and opening and closing too late, of exhaust, &c.—all of which would be detrimental to the power of the engine. But I should advise you to take a pair (one from each end) of diagrams, and send them to the "E. M.," with particulars, and you shall have further and more reliable information.—Engineer, Dewsbury.

[51608.]—**Patterns for Boots and Shoes.**—If "Politzer" will advertise his address, I will send him the book he wants.—E. Fitch.

[51617.]—**White Metal.**—White metal is prepared by melting together tin 84 parts, lead 16, antimony 5, zinc 1, and copper 4.—E. A. H.

[51621.]—**Glue.**—The "Workshop Receipts" says waterproof glue is prepared with skimmed milk instead of water, about two quarts to 1lb. of glue. Acidulate with acetic acid.—T. P.

[51621.]—**Glue.**—Take shellac 3 parts, and india-rubber 1 part by weight. Dissolve each separately in ether free from alcohol, then mix the two solutions together and keep in a well stoppered bottle. This glue will resist the action of water, hot or cold, acids, and most of the alkalies. This glue may be thinned by adding more ether, and used as a waterproof varnish for applying to the joints in leather where it is sewn.—Harry Scott.

The importation into the United States of tin-plate for the calendar year 1882 amounted to 240,000 tons, valued at £3,600,000 in dock at Liverpool; but by the time duties, freights, interest, and importers' and jobbers' expenses and profits were added, these represented a cost to the American consumer of not less than £6,000,000.

The American *Granite Cutters' Journal* says:—"From surveys and calculations made by Mr. J. A. Farrington, civil engineer, the famous Washington boulder, near Conway Corner, N.H., is found to measure 30ft. in height, 46ft. in length, 35ft. in width, and to weigh 3,867 tons. This is the largest known *isolated* piece of granite in the world."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

50956.	Engines, Compound, Non-Condensing, p. 419.
50962.	Locomotives, &c., 419.
50964.	Erlenmeyer's Flask, 420.
50966.	Bisschop Gas Engine, 420.
50971.	Continental Schools of Art, 420.
50977.	Jute Manufacture, 420.
50978.	Windmills, 420.
50998.	Netting, 420.
51000.	Area of Bedroom, 420.
51001.	Chimney Cowl, 420.
51003.	Electrotyping (single cell), 421.
51006.	12ft. Launch, 421.
51014.	Secondary v. Primary Current, 421.

51236.	Jacketing Cylinders, p. 513.
51237.	Through Piston Rods, 513.
51242.	Secretary's Liability, 513.
51243.	Resistance Machines, 513.
51246.	Conveying Pipes Across a River Bed, 514.
51249.	Killing Mice by Electricity, 514.
51251.	Sulphuretted Hydrogen, 514.
51264.	Calculating Wheel, 514.
51267.	Hot-air Engine, 514.
51272.	Sugar Manufacture, 514.
51273.	Hereschoff Propeller, 514.
51285.	Defective Dynamo, 514.
51289.	St. George's Telephone, 514.
51290.	Making Glass Impervious to Steam, 514.
51292.	Magneto-Electrical Machine, 514.
51295.	The Tricycle for Sea and Land, 514.

QUERIES.

[51622.]—**Chemical.**—Can ammonia carbonate be readily or easily transformed into—

1. Hyposulphite of ammonia.
2. Bisulphate ,, ,,
3. Bisulphite ,, ,,

If so, how? Would the carbonate be the handiest salt of ammonia for the production on the small scale of the above three salts, or is any other (obtainable of a chemist) preferable for the above purpose? Directions how to produce these three salts of ammonia will greatly oblige?—Ship Canal.

[51623.]—**Steps and Landing.**—Would any of your readers kindly suggest the best method of reducing the noise caused by the tramping up and down wood steps? Would coating them with sheet lead have the effect, or could any one recommend some other method which would be effectual as well as cheap and durable?—T. W. T.

[51624.]—**Horse-Clipping Machine.**—Could some one kindly give me instructions how to sharpen and set above?—W. L.

[51625.]—**Hydropathy.**—I feel grateful to Mr. Fennessy and "J. W. C." for their kind suggestions. As the latter has volunteered further information, I shall, as desired, state the symptoms. I am as a rule despondent, but unusually so in wet weather. I suffer at times from giddiness, the result, I believe, of flatulency. I have an exceedingly weak stomach and am seldom free from a foul tongue. I also suffer from constipation and am very hard to operate upon. There is waste from the generative organs, and I generally have a feeling of lassitude. I also suffer from loss of memory. "J. W. C." says that I should take but three meals a day, and that I should take porridge for breakfast and supper. Does he mean that supper is to be the third meal? If so at what hour should I take it? How long should I remain under the cold shower? "J. W. C."'s kind instructions on these points will much oblige.—Sufferer.

[51626.]—**Polishing Shells.**—I have some large specimens of shells. How can I polish them?—H. A. C.

[51627.]—**Removal of Chimney Shafts.**—Three or four years ago the Royal Engineers at Chatham Dockyard blew down some chimneys with guncotton. Can any of your correspondents give some particulars of heights, &c., and why they were not taken down piecemeal—was it for experiments? Did the process of blowing down destroy many of the bricks?—W. B.

[51628.]—**Wrought-Iron Chimney Shafts.**—Have any of your correspondents practial experience of these? Are they cheaper and do they require many repairs?—W. B.

[51629.]—**Watch Jobbing.**—I have a watch that goes too slow; the regulator is pushed to the end. I have tried to regulate it by simply taking up, or shortening, the spring, but I have spoiled the beat. Will "Alfojoe" or some one kindly give me the best and easiest method of taking up or letting out the spring without spoiling the best?—J. J.

[51630.]—**Organ Pipes, &c.**—Can any reader give me any information respecting the measurement of the above, and if there is any book published about the construction of an organ? I want to make pipes for a 5-octave organ and 1½ row of pipes. I want to make what is called an eight-foot tone.—G. R. S.

[51631.]—**Transmission of Sound.**—Allow me to ask for information respecting the transmission of sound in solids, especially iron. Is it by alternate spaces of condensation and rarefaction as in air? If so, what are the size of the waves, and is there any mode of demonstration? Do the particles of iron move in these spaces, and what is the rate of transmission? Any other information on the subject, especially if discovered during the last ten years, will oblige.—G. Baxter.

[illegible]

[illegible]—Setting Valves, &c.—Would some cor[illegible] the best way to set the eccen[illegible] and how to calculate [illegible] Also length of piston-[illegible] rods, &c.—A. S.

[illegible]—Cutting Keyways.—Can any reader tell [illegible] of a good rule as to size and depth of keyways in wheels of different sizes, &c.?—A. S.

[illegible]—Fixing and Erecting Machines, &c.—I should be greatly obliged if some of our practical [illegible] readers will tell me the best way to fix a line of [illegible] in a direct line with an existing shaft, also one [illegible] with another existing shaft? Also, when you [illegible] an engine, some mills and gearing to fix in new [illegible] how is it best to set to work, so as to make a good

[illegible] I want to know rules [illegible] so as to get [illegible]

[illegible]—[illegible] Calculating Machine.—I [illegible] a description of the [illegible] machine? It [illegible] Cyclo[illegible] impossible to form [illegible]—Joseph Ed[illegible]

[illegible]—Legal.—[illegible] "Lex." [illegible] a back street (10ft. [illegible] Each tenant has [illegible] back entrances, and [illegible] for removing ashes [illegible] the above. The proprie[illegible] have been served with the following notice:—"Now, therefore, the said urban [illegible] give you notice, in pursuance of [illegible] to level, pave, flag, channel, [illegible] the same within the space of 28 [illegible] in the manner following." [illegible] in which they require it to be [illegible] sanitary authority the power to [illegible] proprietors to make good the above [illegible] compel it to be done in what[illegible]—H. J.

[illegible]—[illegible] and Equilibrium.—[illegible] sustaining one cwt. [illegible] me hour by work done on the [illegible]

[illegible]—Chimney Flues, &c.—Ought the internal [illegible] chimney-shafts be larger diameter at [illegible] and if so, what is the reason?—[illegible]

[illegible]—The Australian Colonies.—Is there [illegible] an architect and surveyor in any of the [illegible] which is the best to go to? What [illegible] and are situations hard or easy to [illegible] on the surveying staff of any [illegible], and if so, by what means?—[illegible]

[illegible]—Bee-keeping.—I have a skep of young [illegible] about two pounds of honey [illegible] tell me what I can feed them [illegible] so that I can keep them alive [illegible] winter?—[illegible] Bees.

[illegible]—Decomposition of Water by Electric [illegible]—What [illegible] of current is required, and [illegible] it?—Will some experi[illegible]—Johnson.

[illegible]—Disinfecting Pictures.—How are gold-[illegible] work pictures, and photo[illegible] the walls of a room during its [illegible] case of small-pox, to be thoroughly [illegible] with sulphur (the means em[illegible] the other contents of the room) [illegible] impracticable?—Rudolph.

[illegible]—Cygni.—Would Mr. Holmes kindly give [illegible] its components? I believe he [illegible] your readers if he will do so. And [illegible] would he also state the aperture he [illegible] the power of his eyepiece?—H. D.

[illegible]—Sleeping Carriages.—Will some corre[illegible] give particulars and principal dimen[illegible] carriages (not the Pulman cars) in [illegible] and North Western, Great Northern, [illegible] expresses?—W. H. Y. T.

[illegible]—Spiral Turning.—In Vol. XIV., No. 360, [illegible] making spiral twist. Would Mr. [illegible] tell me how it works, and [illegible]—H. P.

[illegible]—Stinking Indiarubber Gaspipe.—I [illegible] any reader can tell me how to prevent [illegible] from emitting such a constant [illegible] I suppose, arises from becoming [illegible] of carbon, and oblige?—D. C.

[illegible]—Surveying.—Would some kind reader tell [illegible] the area of circular, triangular, and five-[illegible] and fields which have rivers run[illegible] in all directions? How may I [illegible] the number of tons in old and new hay [illegible]—Agriculturist.

[illegible]—Magnetism.—A compass needle is [illegible] a current of electricity either under [illegible] Will the magnetism of the needle be altered, [illegible] by sending an occasional current [illegible] south end to the centre or point by which [illegible] suspended?—H. J. W., Everton.

[illegible]—Will—Administration.—To Mr. W[illegible].—Three brothers and a married sister. [illegible] intestate. The eldest of the others ad[illegible] divides the property between them. In con[illegible] the Married Woman's Property Act now, I [illegible] law in Ireland, has the husband of the sister any claim on her share?—M. P.

[illegible]—Kidney Beans.—Is there any reliable way of [illegible] kidney beans (scarlet runners), so that they may be used as a vegetable for several weeks after being [illegible]? I have tried a recipe—beans and salt in layers—but they are not useable.—Kaney.

[51684.]—The Other Side of the Moon.—The moon as we all know, presents always the same hemisphere to the earth, and we therefore know nothing of the configuration of her other side beyond what might be inferred from the appearance of the half we are so familiar with. This mystery of the moon, however, was increased tenfold a few years ago by the discovery that her centre of figure and centre of gravity did not correspond—the latter being about eight geographical miles nearer the "other" side. The consequences are startling in the extreme. It follows that all the water which may be on her surface, with any atmosphere she may possess, and, therefore, all life such as we are acquainted with, would be attracted by the force of gravity to that tantalising "other side" which is for ever turned from us. I need not dwell on the thrilling pictures of life and movement that arise in the mind—the possible cities, and seas and rivers with their craft, and the busy selenites at their daily occupation (for with our present telescopes they might be discerned), my object at present being to ask "A Fellow of the Astronomical Society," or some other reader, to be so kind as to give me some more particulars regarding the discovery, which I have not seen any reference to in the "E. M." for some time. Who made the discovery (a Frenchman, I think), and under what circumstances? I should also be obliged if particulars were given of the way in which the calculation was made, along with some indication of the effect of the discovery upon the question of inhabitants?—W. G. C.

[51685.]—**Loose Teeth.**—H. W. S. has for some time past been learning to play the flute, and finds that the pressure of the "mouth hole" or "embouchure" against the lower lip (which is necessary in the upper octaves) has caused his front teeth to become quite loose. Can any reader name anything that will tighten them, and oblige?—H. W. S.

[51686.]—**Historical.**—At what date was Christianity introduced into Britain? None of my books agree on the subject?—Euskarian.

[51687.]—**Railway Speed.**—Will some one kindly give the average speed of (1) The Irish Mail? (2) The Scotch Mail? (3) the Highland Express, and oblige?—Euskarian.

[51688.]—**Hydraulic Lift.**—I should feel extremely obliged if any one of our readers would inform me where the largest hydraulic lift is to be seen, and what weight it will raise?—W. J. Bramwell.

[51689.]—**Spectacles.**—I shall feel obliged if some brother reader will answer the following questions:—I am very shortsighted and my eyes are of different foci; I wear glasses in the streets and use a weaker pair for writing. (1) Ought my spectacles to have glasses of different foci, so as to bring the image sharp in each? (2) Ought the glasses for outdoor wear to have such foci as to bring the images of the most distant objects sharp in each eye—I have been told they should not be so deep? (3) Does the eye at 30 years of age tend to alter so as to require glasses of deeper curve, or the reverse?—Old Sminos.

[51690.]—**Metaphysics.**—Will any of our readers inform me where I can get the best work on metaphysics for self-instruction?—T. H.

[51691.]—**Australia.**—Would any fellow reader say if there is any opening or prospect for an electrical engineer in Australia? I understand the working and construction of dynamos and batteries, also the steam-engine?—Pluck.

[51692.]—**Photography.**—I cannot get sufficient density in my negatives this year; have been using "Archer" and "Kingston Special." I have previously used "Uranium" plates, but the photographic stores do not keep them now; can you tell where I can procure them? I have been quite successful with them. I use Edward's Glycerine Developer. I have new ammonia, as I thought it might be that. (2) I have heard that there is a preparation can be used to intensify over-exposed plates after they have been fixed and dried. Can you tell me what this is, or how made? (3) In a negative that has been developed with too small a proportion of ammonia, or an undeveloped negative after it is fixed, can anything be done in the way of re-developing? (4) Toning Bath.—I make my bath with gold 4gr., soda acetate 2dr., water 20oz., and when I have toned about four sheets, I add the same quantity of gold and soda to the old bath; is this right, or should I only add gold and no soda? (5) After using the bath there is always a black precipitate: it does not affect the bath; should it be filtered out?—P. C. W.

[51693.]—**Chandelier.**—I have recently purchased a good three-light gas chandelier which was very dirty. I washed it in a hot solution of soap and soda, which has much improved it; but it is greatly tarnished with black spots. How can I remove them? Is it usual to have them relacquered or burnished?—Chandelier.

[51694.]—**Lawn Tennis Court.**—At a place that I have recently purchased I find a lawn tennis court, which the former owner has laid with stones and concrete to the depth of about 4in., but at present it is too rough for playing on. What is the best and cheapest material to put a smooth coating over the concrete, and which will resist wet and frost? I have asked one of the asphalte companies, but £100 would not do it, and this is out of the question?—H. B.

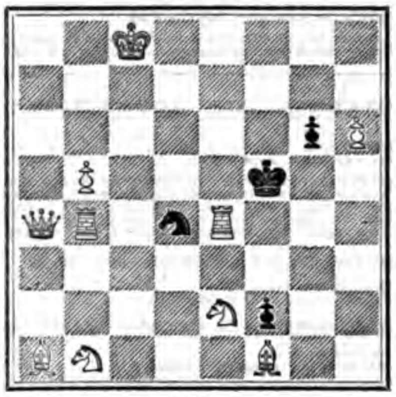
Ensilage Experiment.—Mr. T. H. Miller, of Singleton-park, near Preston, thinks the "silo" for the preservation of green crops need not be a pit or excavation; and he has conducted to a successful issue on the Home Farm, Singleton, an experiment of the greatest interest to agriculturists. He made use of an old cart-house, above which was a granary, the flooring of which he had cut away, with the exception of a portion at one end to serve as a platform. The walls of the building were lined with cement to a height of eight feet, and when this was set the filling of the silo began. Between the 25th of June and the end of August there were placed in it, at irregular intervals, 15 tons of meadow grass in a wet condition, 15 tons 4cwt. of rye grass and clover, and 4 tons 15cwt. of green oats in full head, chopped into 3in. lengths; total 34 tons 19cwt., the produce of seven acres. The mass was kept covered with slotted boards, and weighted with 200 bags containing 126lb. of sand each. These were manipulated easily by means of a rope and pulley, worked from the platform. On the 27th ult. there was no heat or brewing, and but the very slightest perceptible warmth. A portion of the ensilage taken from a depth of 37in., was of a yellowish brown, and moist, but perfectly sweet. A bullock ate some of it greedily, and a handful put in some hay was eaten by a cow before she would touch the hay. The silo is to be formally opened in November in the presence of a number of farmers and friends.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLII.—"Sub Judice."

Black.



White. [10+4

White to play and mate in three moves.

Solution to 850.

White.	*Black.*
1. Kt-Q B 5	1. P takes Kt (a)
2. Q-K B 4	2. Anything
3. Q, R or Kt mates.	
	(a) 1. Kt takes Kt (b)
2. R takes P (ch)	2. Anything
3. Q mates	
	(b) 1. B takes R (c)
2. Q takes B (ch)	2. K takes Kt
3. Q mates	
	(c) 1. B-K sq, &c.
2. R-Q 4 (double ch)	2. K takes Kt
3. Q mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 849 by C. Planck (a good two-mover, sound and totally free from duals), A. E. S. (very fair); to 850 by C. Planck (a very fine and beautiful stratagem) and A. E. S. (with a better first move this would be charming, and perhaps the best of the three-movers); to 851 by Mortimer and C. Planck (neat and well constructed).

R. A. B.—There is no mate your way to 850 if after

$$1.\ \frac{\qquad}{\text{B-K sq (ch)}}\quad 2.\ \frac{\text{K-K 7}}{\text{K-B 3}}.$$

G. H. M. and J. C.—Game received with thanks.

B. G. L.—Thanks for letter.

English Mechanic Tourney game between Mr. Jowett (*White*) and Mr. Vincent (*Black*).

(Scotch Gambit.)

1. P-K 4, P-K 4 2. Kt-K B 3, Kt-Q B 3 / 3. P-Q 4, P takes P / 4. B-Q B 4 (*a*), B-B 4 (*b*) / 5. Kt-Kt 5 (*c*), Kt-R 3 / 6. Kt takes B P, Kt takes Kt / 7. B takes Kt (ch), K takes B / 8. Q-R 5 (ch), P-Kt 3 / 9. Q takes B (*d*), P-Q 4 / 10. Castles (*e*), P takes P / 11. B-Kt 5 (*f*), Q-Q 3 / 12. Q-B 4 (ch), B-K 3 / 13. Q-K 2 (*g*), Q-B 4 / 14. Q Q 2, K-K sq (*h*) / 15. B-R 6, R-K Kt sq (*i*) / 16. P-K R 4, Kt-K 2 / 17. P-Q R 3, Kt-B 4 / 18. R-K sq, B-Q 4 / 19. Q-K B 4, K-Q 2 (*k*) / 20. Kt-Q 2, Q R-K sq / 21. P-Q Kt 4, Q-B 6 (*l*) / 22. B-Kt 5 (*m*), P-K 6 (*n*) / 23. Kt-B sq, R-K 5 / 24. Q-B 3, P-K R 3 / 25. B takes K P (*o*), P takes B / 26. P takes P, Kt takes R P / 27. Q-K 2, K-B sq / 28. Q R-Q sq, B-K 3 / 29. Q-Q 3, Q takes Q / 30. P takes Q, R-Kt 5 / 31. Kt-R 2, R takes P (ch) / 32. K-R sq, R takes Kt (ch) / 33. K takes R, Kt-B 6 (ch) (*p*) / 34. Resigns.

Notes.

(*a*) Kt takes P is considered to lead to a stronger attack.
(*b*) P-Q 3 may also be played with advantage.
(*c*) Bad.
(*d*) Q should first check at Q 5.
(*e*) Q takes P is inferior.
(*f*) Gossip gives here $\frac{\text{P-Q B 3}}{\text{B-K B 4}}$. The text move seems to play Black's game.
(*g*) The position indicates that White's fourth move is weak, as his opponent has now gained a P; his pieces are well out with two centre pawns to the front.
(*h*) We prefer K R-K sq as more attacking.
(*i*) To allow the Kt to be moved to assail the strongly placed B: also with a view to playing P-K Kt 4.
(*k*) Evidently Q cannot take Q B P.
(*l*) A good move.
(*m*) We should prefer Kt-B sq.
(*n*) Now for the tug of war
(*o*) Nothing better: he may now cry "peccavi."
(*p*) A neat finish.

A luminous waterproof paper, the *Papierzeitung* says, may be made from a mixture 40 parts pulp, 10 parts phosphorescent powder, 1 of gelatine, 1 potassium bichromate, and 10 parts of water.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

A NEW VOLUME.

This number is the second of Volume XXXVIII. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXVII. will be published next week, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the past volume are recommended to do so at once, as the back numbers soon run out of print.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 12, and unacknowledged elsewhere:—

H. Ash.—W. Kitney.—C. Birchall.—Rev. J. Rawlins.—R. E. Quinn.—Col. Fendall.—R. Irvine.—L. Ames.—G. Kidd.—Rev. H. Harries.—South London Machinists' Co.—G. Legge.—Garnet.—Old Subscriber.—Tyro.—Wm. Cowan.—E. M. H.—Neglected Education.—Imprimatur.—G. Roberts—R. W. A.—Nonplus.—J. E. Spencer.—Shepherd.—Keraulophon.—W. F. Love.—Fred.—V. M.—C. Gravenhall.—Orderic Vital.—J. E. A.—G. Minor.—Amateur.—Carboniferous.—K. S. T.—Luminous.—F. W. Brewer.

Garnet. (Is not the question sufficiently answered in recent replies? Much depends on the pupil. Try what you can do.)—A. B. (The firing composition is always nitre and gum; but the odour is imparted by cascarilla, benzoin, styrax, cloves, vanilla, balsam of tolu, and many other substances. Here is one recipe: Benzoin 4oz., cascarilla ½oz., nitre and gum arabic of each 3 drachms, myrrh 1 dr., oils of nutmeg and cloves 25 drops of each, charcoal 7oz., all in fine powder. Mix with water to a smooth, stiff paste, and mould to shape desired. The quantities of charcoal and nitre can be increased to make inferior or less powerfully-scented sticks.)—E. R. Dale. (Cannot say from your sketch and description; but most likely it is for altering the travel of valve.)—A. R. (To the chief engineer or the master, unless you have influence with owners. Try Ainsley's Manual, published by the author at South Shields.)—B. (The contrary way. What textbooks have you looked into? Most of them contain the diagrams you want.)—W. Netting. (Yes, it is the cheapest; but it will take about 20 cells.)—Paste. (Twist the ends together and electroplate them. See p. 425, last volume.)—W. C. (For nickel-plating, see Nos. 808, 811.)—Harmonium Stops. (You will find a diagram in Vol. XXI., p. 330; but the number is out of print. You must give some idea of the construction of your instrument, as most likely it cannot be put in.)—J. W. Horton. (See p. 336, No. 872. Enough wire should be wound on to make the coil three times the diameter of the core. 2. There are so many that we must refer you to the indices. We know of none for the new subject. 3. Depends on circumstances. Some have lasted, we believe, for 3,000 hours. The Bunsen; but Trouvé's bichromate is probably the most agreeable. The other question is answered by the advertisements.)—Photog. (All you have to do is to get some positive collodion.)—H. A. O. (See pp. 198, 223, Vol. XXVII., and the indices.)—Van Tromp. (Yes, by lantern and slides.)—J. H. D. A. (See list of Back Numbers in this column last week.)—Black Beetle. (Powdered borax is said to be an efficient remedy. See pp. 391, 517, 569, 596, Vol. XXIII. It is placed in all their haunts and stuffed into the holes from which they emerge. It may be mixed with meal or sugar.)—Edward Johnson. (From the Queen's printers, East Harding-street, E.C. Not more than a few pence. 2. Very good.)—Marine Engineer. (See p. 100, No. 836, and obtain Ainsley's Guide from the author, South Shields. See answer to "G. W. R." in the number for August 31.)—Barometer. (Take the height of the mercury in the short leg as a base line for measuring that in the long leg; but why use a bent tube at all?) High Peak. (You have simply not followed the directions, which are very clear and explicit. Instead of having all the cells in one series, you have made each row a series. Start at one end, and couple all the cells, so that you have only two terminals, and try again. The solution will destroy the zincs quite quick enough, without being made stronger.)—H. Hagensen. (Could be, of course: but what good would they be? It would cost much more work to wind them up than they would give out, and the fall is too little. Besides, you would want about a ton to do anything at all.)—W. J. B. (An almost identical query was inserted on p. 539, No. 959, and was replied to on pp. 551, 561, last volume.)—Tilbury. (Yes; but the Lord Chancellor has special powers. We suspect you would have to obtain a special Act of Parliament, and prove that the payment was omitted by inadvertence. You could obtain patents in foreign countries;

[illegible] will be very [illegible] that the English [illegible] is published [illegible] the formulæ explained [illegible] —E. S. [illegible] was illustrated and [illegible] XXXV. —[illegible] in the first [illegible] is to regulate the amount of fees [illegible] the Act extends to all patents [illegible] of applications [illegible] a physician. Read an [illegible] —A Con- [illegible] were [illegible] Most of them can be found [illegible] must be scraped [illegible] by the remedies [illegible] are made in a variety of ways [illegible] the draught. [illegible] the steam can [illegible] will not need an outlet to [illegible] of those which is [illegible] you must have an [illegible] say where that should be [illegible] the boiler and the pipes.— [illegible] a reference to the page, [illegible] what you wish to do, or [illegible] You [illegible] chemicals—not druggists. It [illegible] All depends on the sketch [illegible] have really had practice in [illegible] would probably be useful: if not, [illegible] anticipated, or are not of [illegible] If practical, they [illegible] no more space to [illegible] Mr. Wetherfield's last reply.— [illegible] but time, and [illegible] are in the tar will [illegible] superior. The [illegible] the best you can have; [illegible] one.—A Con- [illegible] parts: we published the [illegible] experience has been that [illegible] applied regularly [illegible] It is remarkable [illegible] eyes shut. The two [illegible] introduced in an early stage [illegible] established, and now, six [illegible] want to start afresh with [illegible] writings." At the risk of [illegible] the ENGLISH MECHANIC [illegible] Mr. [illegible]'s grounds for his [illegible] we must decline to follow [illegible] 1. You can call yourself a [illegible] people do with quite as [illegible] As to the [illegible], we must decline to [illegible] be safer and more business- [illegible] you had obtained it.—A [illegible] 1. Yes; 2 Yes; 3, Doubtful. [illegible] always be given. Are you quite [illegible] a yearly tenant? Perhaps you [illegible] by consulting a solicitor before fight- [illegible]

USEFUL AND SCIENTIFIC NOTES.

◆

The Fossil Footprints in Nevada.—Much [illegible] in American scientific circles [illegible] supposed human footprints dis[illegible] in the yard of the Nevada [illegible]. Dr. Harkness, of the [illegible] Academy of Sciences, has affirmed that [illegible] were made by a race of big-footed [illegible] O. C. Marsh, of Yale, combats [illegible] The footprints are in six series, each with [illegible] right and left tracks, the stride being [illegible] in extent. The individual foot[illegible] to 20in. over in length and about [illegible] The distance between the line of the [illegible] and left-hand tracks, or the straddle, is [illegible] Professor Marsh considers that the [illegible] footprints, and especially the width [illegible] right and left series, is strong evidence [illegible] were not made by men. He believes a [illegible] explanation is that the impressions [illegible] tracks of a large sloth, either mylodon or [illegible], remains of which have been found in [illegible] the same horizon. The footprints are [illegible] exactly what these animals would make if [illegible] feet covered the impressions of those in [illegible] The size, stride, and width between the [illegible] series of impressions all point to the [illegible] the mylodon or morotherium might [illegible] to make. Since expressing these views [illegible] National Academy of Sciences Professor [illegible] photographs and casts of the [illegible] and has been confirmed in his opinion [illegible] human tracks were made by [illegible] toothless animals, to which the [illegible] armadillo belong. The important [illegible] that some of the tracks [illegible] of the forefoot; and the latter are [illegible] of the large footprints, as would [illegible] if the animal changed its [illegible]

[illegible] in the Southern States, in operation [illegible] cotton factories. This [illegible] all the cotton factories in New [illegible] of Massachusetts, and exceeds by [illegible] State. The figures speak for [illegible] an outline of what the South [illegible] of becoming her own producer, [illegible] and consumer.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at [illegible], Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

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	s.	d.
Sixteen words	0	6
For every succeeding Eight Words	0	6

⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O's.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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6s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 6d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 6d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXX., XXXI., XXXII., XXXIII., XXXIV., XXXV., and XXXVI., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI. and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills have many competitors, though no equals, for supplying the young and delicate with a simple, strengthening, and purifying aperient. These Pills, composed of the finest balsams, are particularly adapted for all complaints peculiar to females, and are most serviceable at the critical periods of early and mature years.

OUR EXCHANGE COLUMN.

◆

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆

Wanted, all kinds of useful **Apparatus**, in exchange for offers or cash.—CAPLATZI, Science Depot, Chenies-street, Tottenham-court-road.

"**English Mechanics**," volumes or odd numbers looked out for specialities. Will exchange for lathe appliances or scientific apparatus. Stamp. — LINSCOTT, Addington-street, Ramsgate.

Quarter-horse Horizontal, Slide-valve, high pressure ENGINE, made to scale, perfect, Ariel governors; magnificent; under massive glass case, gold and electro-plated. Cost £65. Exchange.—Mr. SEEL, F.R.H.S., Stalybridge.

44in. Meteor **Tricycle**, splendid condition; in exchange for American Organ, or small screw-cutting Lathe.—H. W., 4, St. Aubin Villas, Crescent, Stamford-hill, N.

Gas Engine and Lathe wanted. Can give Photographic Apparatus, Tricycle, Chemicals, Gun, Engine Castings, many other things.—Apply, with offers, through WILLIAM BRADSHAW, Enniskillen.

Bicycle, 53in., ball bearings to both wheels, ball pedals, hollow front and back forks, bent handle bar, all bright, little worse than new, cost £20; will exchange for a strong 5in. centre (or thereabouts) screw-cutting lathe.—J. C. P. HAWKS, Bank Top, Gateshead-on-Tyne.

Large pair of **Steelyards**, to weigh 18cwt., little worn, by Avery. Take good exchange. Approval.—D., care 310, Bilston-road, Wolverhampton.

Anglo-German **Concertina**, 20 keys, screwed notes, cost 9s; and achromatic pocket Telescope, two eyepieces and sun-glass, for Violoncello, Metronome, &c.; Amateur Organ or offers.—L., 29, St. Augustine's-road, N.W.

Wanted, part of **Shaping** or Similar Machine, capable of right and left traverse 9 to 12in., and to rise and fall. It is to place on table under circular cutter already mounted on spindle.—J. V. R., 39, Lower Sackville-street, Dublin.

Tricycle.—Ironwork fitted ready for wheels, works hands and feet; for rubber tires, workman's watch, or offers.—A. W., 16, West-street, Maryland Point.

Gun-metal **Slide-Rest**, suit 4½ or 5in. lathe. Exchange lathe, engine, photo. apparatus, *Design and Work*, tools, or offers.—GIBSON, 348, Nursery Cottages, High-street, Gateshead.

Half Horse-Power Horizontal **Engine**, turned fly and driving wheels, on iron bed, &c. What offers?—W. ALGAR, Stonard-road, Winchmore-hill, London, N.

Electrical.—12in. Plate-glass Machine, on polished mahogany stand, discharging rod, Leyden jar, electro-magnet, handsome saloon pistol, &c. Wanted, good slide-valve engine, 1¼ to 2in. bore.—R. W., 51, Courthill-road, Lewisham.

Magic Lantern, three inch condenser, focussing tube, lamp, 5ft picture, complete, cost 25s. What offers?—JEFFERIES, 3, Gipsy Villas, Gipsy-road, Lower Norwood.

One or two Three Guinea full-sized **Frock Coats**, very little worn, exchanged for portable telescope; good twenty miles.—H., 27, Fearnlea-road, Balham, Surrey.

Vols. I., II., III., "**Knowledge**," unbound; Vols. XIII., XIV., ENGLISH MECHANIC, bound; Darwin's "Origin of Species;" for Theobald's No 3 Combination Telescope, complete.—B., 147, Farringdon-road Buildings, London.

Camera, with telescopic mahogany body, 9in. by 8in., stereoscopic front, splendid lens, with rackwork, dark slides, &c. Exchange.—THOS. LISLE, Villiers-street, Wolverhampton.

Microscopic.—Anther Malope Grandiflora, beautifully mounted on opal or ordinary slide. Exchange.—KILGOUR, 63, Dallfield-walk, Dundee, N.B.

Splendid **Flutina**, by Busson. Will exchange for good violin and bow, or Anglo steel-reed Concertina. Also for exchange, small battery and coil.—H. WEBB, Bootmaker, 1, Bell-street, Wolverhampton.

"**Knowledge**," "Amateur Work," "Universal Instructor," "Public Opinion" (from 1881), all complete to date, with indices, clean and perfect; cost 65s. Musical exchange wanted, or offers.—H., 2, Rose-street, Cornbrook, Manchester.

Emery Wheel, 2ft. by 3in., a rapid fitter; quantity of Marble Letters, suit builder; enough for the following words:—Carpenter, Builder, and Undertaker. One Leaden Generator and Vat.—10, Pitlake-bridge, Croydon.

Wanted, Sociable **Tricycle**, good make, any condition; exchange Bicycles in perfect condition.—W., 89, Maxey road, Plumstead.

Good English eight-day striking **Clock**, in long oak case, 54in. Bicycle, and a capital Treadle Sewing Machine; exchange Photographic Apparatus, or offers.—A. GARDNER, Towcester.

Fifty numbers "**English Mechanic**," from 235 to 537; also several indices, and Volume XVI., complete, unbound. Exchange.—H. HAWKINS, Hinton, Martock, Somerset.

Wanted to exchange, first-rate **Violin**, bow and case, for good Photographic Apparatus, complete.—G. LEGGE, Aylesbury.

THE SIXPENNY SALE COLUMN.

◆

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

◆

Bicycles, Tricycles, Wheels, and parts, and frames complete.—W. GWINNETT, AND Co., Wednesfield-road, Wolverhampton.

Electrical Depot and Manufactory.—Handiest shop in the trade for amateurs.—MILLAR'S, 126, Chapel-street, Salford.

Motor Castings, materials for Electric Bells, Batteries, Galvanometers, Intensity Coils, Microphones, Terminals.—KING and Co., Bristol.

Wimshurst Influence Machine; complete; with two Leyden jars, £3 10s., 4½in. spark.—Makers, KING and Co., Bristol.

Wimshurst Influence Machine, sole manufacturers; high-class workmanship; numerous testimonials as to thorough efficiency.—KING and Co., Bristol.

Violin, the Collin-Mezin Violin (the finest new violin made). Approval allowed.—Importer, ALPHONSE CARY, Newbury.

Violins, by Signor Verini, splendid tone; price 5 guineas. Trial allowed.—Sole Importer, ALPHONSE CARY, Newbury.

Violins, splendid copies of old masters, 28s., 36s., 47s., and upwards. Approval allowed.—ALPHONSE CARY, Newbury.

Violin Strings (finest Italian imported), very durable. Three Firsts free for 13 stamps.—ALPHONSE CARY Newbury.

Pyrotechnic and Trade Chemicals.—Lowest price at GAUBERT and KELLY'S (late Page), 47, Blackfriars-road.

10,000 Artistic **Photographs**. Popular celebrities Actresses, Celebrated Paintings, Antique and Modern Sculpture, Classic Studies for Artists, &c. Unrivalled collection. Packets are sent for selection, post free. Catalogue and specimens, 6d.—T. WILLIAMS and Co., Photographic Publishers (P 13), Bridgnorth. Agents wanted.

Turned wrought-iron **Pulleys**, not polished on a grindstone like those generally sold. Cheap, strong, true.—BAGSHAW and SONS, Batley.

Friction Pulleys dispense with fast and loose pulleys—one answers for both. Invaluable for ropes and belts. Illustrated circular free.—BAGSHAW and SONS, Batley.

Microscopic. — The beautiful building Rotifer, Melicerta Ringens. Large healthy specimens, tube, 9d.—[illegible], Ayr, Scotland.

£2 7s. 6d. for **Square Piano**, in good order, sweet tone.—TERRILL, 2, Tottenham-street, London, W.

Electric Bell, Indicators, Batteries, Wire, Carbons, and Sundries, &c. List one stamp.—E. CRICK, 9, St. James's-walk, E.C.

Steam Launch, 30 feet by 6, fast, nearly new, price £130.—Dr. DIXON, Stockton-on-Tees.

in *use* up to date. His 78 pages of letterpress contain much original matter; we should be glad to see the pamphlet doubled in bulk, still preserving the character of practical notes.

THE CULTIVATION OF SORGHUM.

THE cultivation of sorghum is just now attracting considerable attention in the United States, and it so happens that it is a question of some interest to many in this country; for if it should prove to be profitable, many capitalists will invest their money in land in the Far West, many of the corn growers already located there will grow sorghum, and there will be less wheat to export. Until very recent times a crop of sorghum had no very definite value; for, although the great millet is a staple article of food all over Asia, Africa, and part of Europe, the stalks forming good fodder for cattle, the fruit has not been considered as a valuable cereal in the United States. Sorghum vulgare, however, possesses a saccharine juice, which it has been comparatively recently discovered can be converted into sugar—that is, the sucrose of the sugar-cane, Saccharum officinarum. Sorghum has always been grown in parts of the United States for the syrup it yielded, and for fodder, while the seed or grain was used for feeding pigs, poultry, &c.; now that a method of making sugar from it has been laid down in all its details, there will probably be an enormous increase in the area devoted to its cultivation, for the simple reason that the United States consumes annually about 2,000 million pounds of sugar, nine-tenths of which is imported. It must be remembered that the sugar cane itself grows to perfection scarcely anywhere in the States, though, in Louisiana it is the staple and probably most profitable crop; but the Sorghum can and does flourish as far north as Dakota, and will reach perfection in all the States lying in the centre of North America. That it has not hitherto been cultivated as a sugar-yielding plant is due to the fact that the production of sugar from the juice could never be relied upon: sometimes the sugar would crystallise out beautifully, at others the juice obstinately remained as syrup. The difference between sorghum and saccharum juice is just that which is understood by glucose and sucrose, or grape sugar and cane sugar; but it was known for some years that the juice obtained from sorghum contained sucrose, though it was only occasionally and, as it were, by accident, it could be induced to crystallise out of the syrup. Accordingly, the question was taken up by the United States Department of Agriculture, and a series of elaborate analyses of sorghum were made at various stages during the growth of the plant. It was then found that in the latter part of July the sorghum juice contains more glucose than sucrose; but from the beginning of August the quantity of sucrose increases rapidly until the seeds begin to harden, when the increase is checked, and when the seeds are fully ripe the sucrose has reached its maximum, which is equal according to locality and variety of the sorghum to the percentage of sugar obtained from the sugar-cane. In some localities and with some varieties sorghum gives a greater yield than saccharum, and in the South of Russia, where experiments have been made with it lately, the yield has been from nine to fourteen per cent. While the sucrose increases in the sorghum plant the glucose decreases, and the object of the cultivator is to cut his crop at the time when the sucrose is at a maximum and the glucose at a minimum. He has often done that, and yet failed to obtain sugar. The reason has been found in the fact that sorghum juice, unlike that of the sugar-cane, is remarkably unstable, and has a perverse tendency to change all its sucrose into glucose within a very short time. The cause of the failure to obtain sugar being known, the remedy was easily found, and that is to boil the juice as soon as the plant is cut. The transformation can, it is stated, be prevented by the use of lime; but practically the sugar will, in future, be secured by prompt boiling of the juice as fast as it is obtained from the recently-cut plants. In the light of knowledge, it is easy to explain why sorghum juice was found so capricious, at one time yielding beautifully crystallised sugar, and at another (most frequently) only nice syrup. It may be safely predicted that before long the United States will produce all the sugar required by its inhabitants, and that the great millet will be cultivated in Africa and Asia and parts of Southern Europe for its sugar as much as for its seeds.

PRESERVING FRESH MEAT.

A METHOD of preserving fresh meat by means of a mixture of carbonic oxide and carbonic acid in certain proportions, has been recently patented by Mr. C. M. Pielsticker, of Sidney-terrace, Kilburn. Carbonic oxide, as is well-known, is highly inflammable, and mixed with atmospheric air in certain proportions is explosive. Carbonic acid gas by itself discolours the fresh meat fibre, and causes the meat to assume an acid taste. By using a mixture of carbonic acid and carbonic oxide in certain definite proportions (say not less than 55 per cent., nor more than 75 per cent. of carbonic acid gas, to not more than 45 per cent., nor less than 25 per cent. of carbonic oxide gas, in which the presence of any nitrogen gas is immaterial), the meat is neither changed in the slightest degree in appearance or taste, nor is it at all possible to set fire to the mixture of gases, it being a well-known fact that no flame or fire can exist in the presence of carbonic acid gas, even if united with three times its volume of atmospheric air. The mixture of gases is produced by means of an apparatus forming part of the invention, which is constructed in the following manner:—

An iron, or other suitable cylinder, say 2ft. high and 8in. diameter, or larger in these proportions, is furnished at the bottom with ordinary grate bars. About 2in. above the grate is an inch hole in the side of the cylinder for the admission of a forced air blast by means of a pair of bellows or otherwise. Near the top of the cylinder a number of 1in. pipes enter all round circumference and project about 2in. inside the cylinder for the admission of air into the upper part of the cylinder. The number of these air pipes is in the proportion of one to every 2in. of diameter of the cylinder, so that for instance a cylinder of 8in. diameter requires not less than four air pipes, which in practice give the correct proportion of carbonic acid and carbonic oxide gas. The cylinder is closed at the top with an iron cap, having an outlet pipe say 2in. in diameter and 2ft. or more in length; it is connected with an iron coil placed in a water tank and kept cool by the circulation of cold water. The lower end or outlet of the coil is connected with the preserving chamber. In order to produce the mixture of gases, the patentee fills the cylinder with wood or mineral charcoal, and having ignited it, applies a blast through the hole left for that purpose in order to promote combustion. The gas which arises consists mainly of carbonic oxide gas mixed with some carbonic acid gas and also nitrogen gas, which latter need not be considered. In the upper part of the cylinder the carbonic oxide is further partly oxidised into carbonic acid gas by the further supply of atmospheric air. When the number of 1in. air pipes is in the proportion of one to every two inches of the diameter of the cylinder, the mixture of gases is in correct proportion to each other, and they neither change the taste and appearance of the meat nor are in the slightest degree inflammable. The gases pass through the coil, where they are cooled, into the preserving chamber, with which the lower outlet of the coil has previously been connected. The mixture of gases may be passed into and through the preserving chambers continually during the voyage of a steamer, or the air in the preserving chambers may be merely removed, the chambers well filled with the mixture of gases and then both inlet and outlet closed, or the gases may be again exhausted after treatment, and a partial vacuum left in the chambers. The mixture of gases may be either used by itself, or as an after treatment following the use of any antiseptic.

ZINC FOR PREVENTING BOILER CORROSION.

THE use of zinc for preventing corrosion in steam boilers has formed the subject of several patents, and recently Mr. J. B. Hannay, of Glasgow, has obtained a patent for further improvements on his invention of 1881. According to the present invention the zinc masses of spherical, or spheroidal, or polyhedral, or cubical form, or other form having small difference of thickness in different directions, are rendered more durable and efficient by being brought into the condition known as malleable, instead of being used in the condition they have when simply cast. For this purpose the masses are hammered or forcibly pressed or rolled, the operation being by preference effected suddenly. Thus a convenient and satisfactory means for the purpose consists of a powerful screw press fitted with a heavy flywheel or heavily weighted arms and provided with suitably shaped dies. By a further improvement the zinc is made more susceptible of being rendered malleable by being alloyed with a small portion, say, not more than 10 per cent. of lead, tin, or copper. Another improvement consists in carrying each of the zinc masses in the boiler in an iron ladle of suitable size, such ladle being clamped to some of the tubes or fixed inside the boiler in any convenient way, and not requiring to be removed when supplying new blocks or balls of zinc, as such blocks or balls have simply to be placed in the ladles after those have been cleared out.

The patentee claims as novel and original—1. The use of zinc blocks or masses of a spherical, or spheroidal, or polyhedral or cubical or other similar form for preventing corrosion in steam boilers, such blocks or masses having been subjected to compression after having been cast. 2. The forming of the blocks or masses of zinc alloyed with 10 per cent. or less of lead, tin, or copper, and subjected to compression after having been cast.

PATTERN MAKING.—XV.

Strap Pulleys (*continued*).

THE arms of pulleys, or of riggers (Fig. 71) as they are sometimes called, are usually curved, except in the case of those of very small diameter. This curving is considered essential in these light castings, lest the shrinkage of the boss which remains hot longest should tear the too rigid arms asunder, either in the mould or at some subsequent period. Straight arms would be unyielding, while curved ones are somewhat analogous to a bent spring. For the same reason, also, the greatest care is necessary in properly proportioning the metal in the different parts—boss, arms, and rim. To reduce the metal in the boss is the great essential. A heavy boss will infallibly break either the arm or the rim. If the rim is very rigid, the arm will break, while, if the arm be too strong the rim will break. In either case, the mischief is due to the internal tension or stress set up through the contraction of the boss continuing after the rim and arms have cooled down and set. Hence, let the pulley be so proportioned that the boss shall contract very little after the other parts have cooled—so little that the moulder can counteract that small excess by opening the mould around the boss and allowing it to cool while the rim and arms still remain covered. Make the boss as light as possible consistently with safe working, and give the necessary strength for keying, by adding a keyway boss (Fig. 71.)

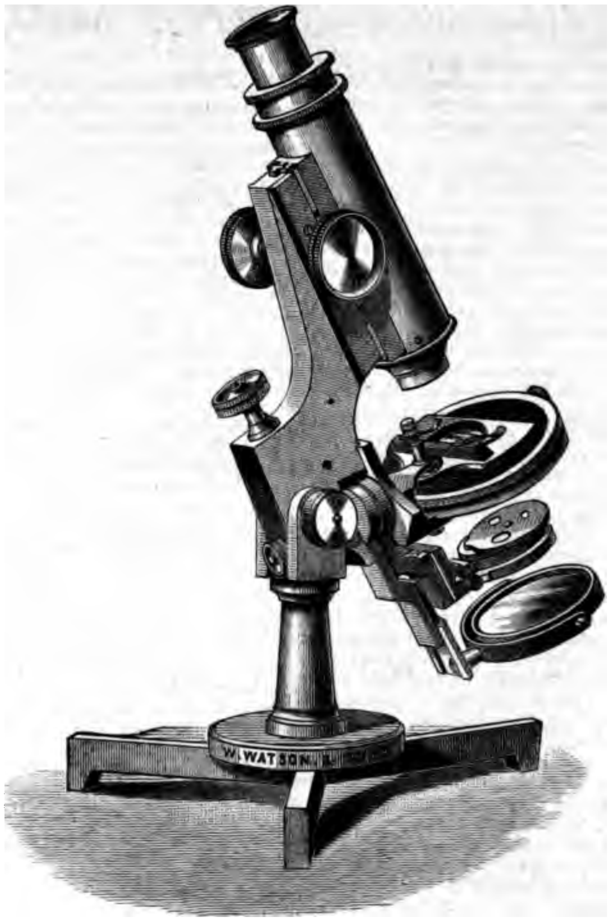
To proportion pulleys. Let the rim be from $\frac{3}{16}$in. thick in small riggers to $\frac{1}{4}$in. or $\frac{5}{16}$in. in large ones. For pulleys running at a high speed give an $\frac{1}{8}$in., or $\frac{3}{16}$in. rounding per foot wide of surface; for those running at slow speeds, say, $\frac{3}{8}$in. of rounding per foot. This rounding must be omitted in the pattern, except where it happens to be parted in the centre, care being taken, however, to allow sufficient thickness of rim to permit of the casting being turned to this extent in the machine shop.

For the curves of the pulley arms set rules could be given; but, for my part, I never use then, preferring simply to line out roughly with pencil an arm which has a graceful appearance, and then adapt radii to it. In giving to the arms their *cross sections* a trained eye is almost as good as rules; but in the absence of experience, the following rule gives correct results for pulleys doing ordinary work.

$$\sqrt[3]{b} = \frac{d \times w}{n \times 8}$$

where b = breadth of arm at point.
d = diam. of pulley in inches.
w = breadth of rim in inches.
n = number of arms.

Thus, a pulley 4ft. in diameter by 9in. wide, having six arms, would have an arm 2in. wide at the point. Near the boss the arm should be one-third wider than it is at the rim. Its section



which is pressed against the lever by a strong spiral spring. It is claimed for this system of fine adjustment that there is less lateral rocking than in the Zentmayer system. The stage is circular; it can be rotated completely, and centring screws are provided, by which it can be made to rotate exactly on the optic axis. The "Tighlmann" friction movements carry the object, and a simple mechanism enables the operator to remove the stage-plate and substitute a glass stage for chemical reactions, &c. Two tail-pieces are provided, one carrying the sub-stage, the other the mirror; they swing laterally, either together or independently, on the same axis, the suspension being arranged as in the Zentmayer form, so that the movement is radial with the object, and in the plane of the optic axis. The substage is of the standard gauge (1½in.), and ordinarily carries a conical diaphragm. A condenser can, of course, be substituted.

On the whole this little microscope appears to be a good working model, and we think Messrs. Watson deserve credit for introducing it to this country at a price which will enable it to compete favourably with the American microscope on which it is based. We understand that the Editor of the *Journal* of the Royal Microscopical Society has commended this form as one of the best student's microscopes yet issued.

We would suggest to Messrs. Watson the advisability of applying a clamp-screw to the tail-pieces so that they may be fixed rigidly in the normal position when axial light is being used. We also think it would facilitate the manipulations of the substage and mirror if the pillar support were taller so as to permit the tailpieces to be longer. At present the tailpieces are so short that there is some difficulty in adjusting the illumination beneath the stage, especially when the microscope is vertical.

THE DIALYTE TELESCOPE.

By W. Bradbury.

IT may not be unserviceable to those who wish to take up this kind of telescope, if I give a précis of the accounts of several instruments which have been successfully made on this plan. I am enabled to do this by the kindness of "J. C. L.," who has sent me several odd leaves of early volumes of this journal where these descriptions appear. I shall purposely avoid all theory as much as possible, because I believe more can be done with this construction by following a good model, than by bothering with calculations, which at best can only be a guide, and very likely less to be depended on than the model. In the ordinary object-glass, definition is obtained by adjusting the *faces* of the lenses, but in the dialyte it is got by altering their *places*. Hence, no very exact arrangement of surfaces is necessary, because the final result will depend on how the various elements can be correlated; and this no theory can determine.

I commence with an account furnished by "Hyperion" on p. 586, No. 311. This relates to a dialyte made by Mr. Wray. I give in Fig. 1 a diagram of the lenticular arrangement.

Density of crown glass = 2·50 : of flint = 3·65.

8¼in. equiconvex object-lens, radius 130, focus 120.

4½in. correctors, consist of:—

Double convex crown lens, radii 130 and 12·5.

Meniscus flint lens, radii 12·5 and 130.

The two 12·5 inner faces in contact and cemented.

"When this corrector was placed in the tube, the combined focal length of the telescope was increased to 11 ft.; but the virtual focus gained by the concave was 13ft.; so that with a focal length of about 11½ft., the same magnifying power was obtained as if that focal length had been 13ft."

"The action of the corrector was to cause achromatism in the front lens of 8¼in. aperture, and so it did (remarks Mr. Wray), for the central pencils of rays; but the oblique pencils were deeply tinged with colour, which required a peculiar form of eyepiece to correct. The correction of achromatism was similar to that in an ordinary object-glass, for even in the centre of the field where it was most perfect, the usual secondary spectrum appeared.

"The main objection, however, to this form of telescope, arose from the great difficulty of keeping the corrector precisely in the axial line of the object-lens, and so preserving the right centring of the lenses, without which accurate definition was impossible. Flexure, too, would show its evil effects in a construction where the component lenses of the objective were separated by so large an interval, much more than if they were in contact.

"In its best action (Mr. Wray observes), the definition on double stars and planets was very fine, so long as the observer kept the object near the centre of the field of view; but if, from the slightest cause, the adjustment of the corrector happened to be shifted, the *telescope was useless.*"

I next come to Mr. Herbert Ingall's plan,

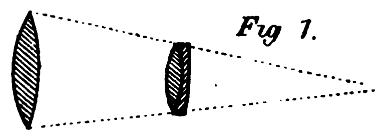


Fig 1.

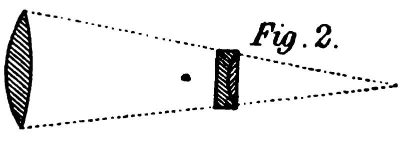


Fig. 2.

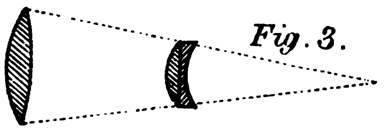


Fig. 3.

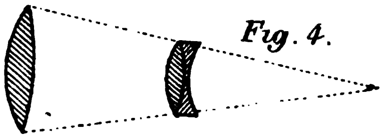


Fig. 4.

described on p. 36, No. 314, and which is shown in Fig. 2.

4½in. object lens, 42in. focus; a crossed lens, radii as 1 : 6.

2¼in Correctors:—

6½in. focus crown lens, "nearly plano-convex, just crossed to avoid having a flat surface, which is uncertain to get correctly."

Flint concave of very dense glass, with curves to match.

The two deeper curves in contact and cemented.

"When this combination was fixed in the telescope-tube with the flint glass towards the object-lens, not only was the colour corrected, but the spherical error was so far diminished as to enable me to 'notch' ζ Boötis, which I did with a power of about 300, in 1865. I perceived, however, that the correctors would correct a much larger diameter lens than the object-glass I then used; so I had another lens worked of exactly the same curves but of larger diameter: but this had some striæ across the centre of the glass, but I saw sufficiently well with this lens to enable me to see that the errors were well balanced. After having two more glasses ground, I got one that was very perfect, and this one I now use in my present instrument.

"My present dialyte has an aperture of 5½in., and the focal length of the instrument is only 5½ft., although from the negative refraction of the corrector, the virtual focus is 96in.—one of the advantages of the construction.

"The telescope is very excellent when in proper adjustment, completely dividing ζ Boötis and notching μ^2 Boötis and ζ Cancri last year with high powers. In fine air, I find great advantage in using a power as high as 772 on the moon.

"The disadvantages of the dialyte are those mentioned by 'Hyperion'—viz., the liability to get out of the centre and the imperfect chromatic correction at the edges of the field, and for this reason I find my telescope appears to perform better with high powers. This colour is perhaps greater in my telescope, as it has what I should call a very exaggerated correction, 5½in. being balanced by a combination of only 2½in. Nothing, however, could be finer than the image of a planet or star in the centre of the field. In fine states of the air, the mottled appearance of the equatorial belt of Jupiter is very beautiful."

Next, on page 524, No. 515, Mr. Ingall says:—"The correction on the dialyte plan can of course be obtained in a great many different ways. The data of my various instruments (being entirely my own from experiment, and accommodation to my available curves) may of course, by no means be the best. In fact, my 5½in., although having such a fine central correction, has a bad *field*, in consequence of the correctors being placed very far back from the object glass." He gives the following data:

4¼in. French plate object-lens, focus 60in., both sides convex, radi 24 and 240 respectively.

I think it may be at once conceded that the truths of geometry are truths precisely because they relate to and express the properties of what Mill calls "purely imaginary objects"; that these objects do not exist, in Mill's sense, that they do not exist in nature, may also be granted; that they are "not even possible," if this means not possible in an existing nature, may also be granted. That we cannot "conceive" them depends on the meaning which we attach to the word conceive. I would myself say that the purely imaginary objects are the only realities, the *ὄντως ὄντα*, in regard to which the corresponding physical objects are as the shadows in the cave; and it is only by means of them that we are able to deny the existence of a corresponding physical object; if there is no conception of straightness, then it is meaningless to deny the existence of a perfectly straight line.

But at any rate the objects of geometrical truth are the so-called imaginary objects of Mill, and the truths of geometry are only true, and *a fortiori* are only necessarily true, in regard to these so-called imaginary objects; and these objects, points, lines, circles, &c., in the mathematical sense of the terms, have a likeness to and are represented more or less imperfectly, and from a geometer's point of view no matter how imperfectly, by corresponding physical points, lines, circles, &c.

Mathematical Theories.

In arithmetic and algebra, or say in analysis, the numbers of magnitudes which we represent by symbols are in the first instance ordinary (that is, positive) numbers or magnitudes. We have also in analysis and in analytical geometry *negative* magnitudes; there has been in regard to these plenty of philosophical discussion, and I might refer to Kant's paper, "Ueber die negativen Grössen in die Weltweisheit" (1763), but the notion of a negative magnitude has become quite a familiar one, and has extended itself into common phraseology. I may remark that it is used in a very refined manner in bookkeeping by double entry.

But it is far otherwise with the notion which is really the fundamental one (and I cannot too strongly emphasise the assertion) underlying and pervading the whole of modern analysis and geometry, that of imaginary magnitude in analysis and of imaginary space (or space as a *locus in quo* or imaginary points and figures) in geometry; I use in each case the word imaginary as including real. This has not been, so far as I am aware, a subject of philosophical discussion or inquiry. As regards the older metaphysical writers this would be quite accounted for by saying that they knew nothing, and were not bound to know anything, about it; but at present, and, considering the prominent position which the notion occupies—say even that the conclusion were that the notion belongs to mere technical mathematics, or has reference to nonentities in regard to which no science is possible, still it seems to me that (as a subject of philosophical discussion) the notion ought not to be thus ignored; it should at least be shown that there is a right to ignore it.

Although in logical order I should perhaps now speak of the notion just referred to, it will be convenient to speak first of some other quasi-geometrical notions; those of more than three-dimensional space, and of non-Euclidian two and three dimensional space, and also of the generalised notion of distance. It is in connection with these that Riemann considered that our notion of space is founded on experience, or rather that it is only by experience that we know that our space is Euclidian space.

It is well known that Euclid's twelfth axiom, even in Playfair's form of it, has been considered as needing demonstration; and that Lobatschewsky constructed a perfectly consistent theory, wherein this axiom was assumed not to hold good, or say a system of non-Euclidian plane geometry. There is a like system of non-Euclidian solid geometry. My own view is that Euclid's twelfth axiom in Playfair's form of it does not need demonstration, but is part of our notion of space, of the physical space of our experience—the space, that is, which we become acquainted with by experience; but which is the representation lying at the foundation of all external experience. Riemann's view before referred to may, I think, be said to be that, having *in intellectu* a more general notion of space (in fact, a notion of non-Euclidian space), we learn by experience that space (the physical space of our experience) is, if not exactly, at least to the highest degree of approximation, Euclidian space.

But suppose the physical space of our experience to be thus only approximately Euclidian space, what is the consequence which follows? Not that the propositions of geometry are only approximately true, but that they remain absolutely true in regard to that Euclidian space which has been so long regarded as being the physical space of our experience.

It is interesting to consider two different ways in which, without any modification at all of our notion of space, we can arrive at a system of non-Euclidian (plane or two-dimensional) geometry; and the doing so will, I think, throw some light on the whole question.

First, imagine the earth a perfectly smooth sphere; understand by a plane the surface of the earth, and by a line the apparently straight line (in fact, an arc of great circle), drawn on the surface; what experience would in the first instance teach would be Euclidian geometry; there would be intersecting lines, which, produced a few miles or so, would seem to go on diverging, and apparently parallel lines which would exhibit no tendency to approach each other; and the inhabitants might very well conceive that they had by experience established the axiom that two straight lines cannot inclose a space, and the axiom as to parallel lines. A more extended experience and more accurate measurements would teach them that the axioms were each of them false; and that any two lines, if produced far enough each way, would meet in two points; they would in fact arrive at a spherical geometry, accurately representing the properties of the two-dimensional space of their experience. But their original Euclidian geometry would not the less be a true system, only it would apply to an ideal space, not the space of their experience.

Secondly, consider an ordinary, indefinitely extended plane; and let us modify only the notion of distance. We measure distance, say, by a yard measure or a foot rule, anything which is short enough to make the fractions of it of no consequence (in mathematical language by an infinitesimal element of length); imagine, then, the length of this rule constantly changing (as it might do by an alteration of temperature), but under the condition that its actual length shall depend only on its situation on the plane and on its direction—viz., if for a given situation and direction it has a certain length, then whenever it comes back to the same situation and direction it must have the same length. The distance along a given straight or curved line between any two points could then be measured in the ordinary manner with this rule, and would have a perfectly determinate value; it could be measured over and over again, and would always be the same: but of course it would be the distance, not in the ordinary acceptation of the term, but in quite a different acceptation. Or in a somewhat different way; if the rate of progress from a given point in a given direction be conceived as depending only on the configuration of the ground, and the distance along a given path between any two points thereof be measured by the time required for traversing it, then in this way also the distance would have a perfectly determinate value; but it would be a distance, not in the ordinary acceptation of the term, but in quite a different acceptation. And corresponding to the new notion of distance, we should have a new non-Euclidian system of plane geometry; all theorems involving the notion of distance would be altered.

We may proceed further. Suppose that as the rule moves away from a fixed central point of the plane it becomes shorter and shorter; if this shortening takes place with sufficient rapidity, it may very well be that a distance, which in the ordinary sense of the word is finite, will, in the new sense, be infinite; no number of repetitions of the length of the ever-shortening rule will be sufficient to cover it. There will be surrounding the central point a certain finite area such that (in the new acceptation of the word distance) each point of the boundary thereof will be at an infinite distance from the central point; the points outside this area you cannot by any means arrive at with your rule. They will form a *terra incognita*, or rather an unknowable land; in mathematical language, an imaginary or impossible space; and the plane space of the theory will be that within the finite area—that is, it will be finite instead of infinite.

We thus, with a proper law of shortening, arrive at a system of non-Euclidian geometry which is essentially that of Lobatschewsky. But in so obtaining it we put out of sight its relation to spherical geometry; the three geometries (spherical, Euclidian, and Lobatschewsky's) should be regarded as members of a system—viz., they are the geometries of a plane (two-dimensional) space of constant positive curvature, zero curvature, and constant negative curvature respectively; or again, they are the plane geometries corresponding to three different notions of distance. In this point of view they are Klein's elliptic, parabolic, and hyperbolic geometries respectively.

Next as regards solid geometry; we can, by a modification of the notion of distance (such as has just been explained in regard to Lobatschewsky's system), pass from our present system to a non-Euclidian system. For the other mode of passing to a non-Euclidian system, it would be necessary to regard our space as a flat three-dimensional space existing in a space of four dimensions (i.e., as the analogue of a plane existing in ordinary space); and to substitute for such flat three-dimensional space a curved three-dimensional space, say of constant positive or negative curvature. In regarding the physical space of our experience as possibly non-Euclidian, Riemann's idea seems to be that of modifying the notion of distance, not that of treating it as a locus in four-dimensional space.

Space of Four Dimensions.

I have just come to speak of four-dimensional space. What meaning do we attach to it? Or can we attach to it any meaning? It may be at once admitted that we cannot conceive of a fourth dimension of space; that space as we conceive of it, and the physical space of our experience, are alike three-dimensional; but we can, I think, conceive of space as being two or even one dimensional; we can imagine rational beings living in a one-dimensional space (a line) or in a two-dimensional space (a surface) and conceiving of space accordingly, and to whom, therefore, a two-dimensional space, or (as the case may be) a three-dimensional space would be as inconceivable as a four-dimensional space is to us. And very curious speculative questions arise. Suppose the one-dimensional space a right line, and that it afterwards becomes a curved line: would there be any indication of the change? Or, if originally a curved line, would there be anything to suggest to them that it was not a right line? Probably not, for a one-dimensional geometry hardly exists. But let the space be two-dimensional, and imagine it originally a plane, and afterwards bent (converted, that is, into some form of developable surface) or converted into a curved surface; or imagine it originally a developable or curved surface. In the former case there should be an indication of the change, for the geometry originally applicable to the space of their experience (our own Euclidian geometry) would cease to be applicable; but the change could not be apprehended by them as a bending or deformation of the plane, for this would imply the notion of a three-dimensional space in which this bending or deformation could take place. In the latter case, their geometry would be that appropriate to the developable or curved surface which is their space—viz., this would be their Euclidian geometry; would they ever have arrived at our own more simple system? But take the case where the two-dimensional space is a plane, and imagine the beings of such a space familiar with our own Euclidian plane geometry: if, a third dimension being still inconceivable by them, they were, by their geometry or otherwise, led to the notion of it, there would be nothing to prevent them from forming a science such as our own science of three-dimensional geometry.

Evidently all the foregoing questions present themselves in regard to ourselves, and to three-dimensional space as we conceive of it, and as the physical space of our experience. And I need hardly say that the first step is the difficulty, and that granting a fourth dimension we may assume as many more dimensions as we please. But whatever answer be given to them, we have, as a branch of mathematics, potentially, if not actually, an analytical geometry of n-dimensional space.

Imaginary Magnitude and Space.

Coming now to the fundamental notion already referred to, that of imaginary magnitude in analysis and imaginary space in geometry; I connect this with two great discoveries in mathematics made in the first half of the seventeenth century, Harriot's representation of an equation in the form $f(x) = 0$, and the consequent notion of the roots of an equation as derived from the linear factors of $f(x)$, (Harriot, 1560-1621; his "Algebra," published after his death, has the date 1631), and Descartes' method of coordinates, as given in the "Géometrie," forming a short supplement to his "Traité de la Méthode, &c." (Leyden, 1637).

There is a well-known construction in perspective for drawing lines through the intersection of two lines, which are so nearly parallel as not to meet within the limits of the sheet of paper. You have two given lines which do not meet, and you draw a third line, which, when the lines are all of them produced, is found to pass through the intersection of the given lines. If instead of lines we have two circular arcs not meeting each other, then we can, by means of these arcs, construct a line; and if on completing the circles it is found that the circles intersect each other in two real points, then it will be found that the line passes through these two points; if the circles appear not to intersect, then the line will appear not to intersect either of the circles. But the geometrical construction being in each case the same, we say that in the second case also the line passes through the two intersections of the circles.

Of course it may be said in reply that the conclusion is a very natural one, provided we assume the existence of imaginary points; and that, this assumption not being made, then, if the circles do not intersect, it is meaningless to assert that the line passes through their points of intersection. The difficulty is not got over by the analytical method before referred to, for this introduces difficulties of its own; is there in a plane a point the co-ordinates of which have given imaginary values? As so arrived at the curves of curvature. (See his "Mémoire sur les Déblais et les Remblais," Mem. de l'Acad., 1781.) The normals of a surface are, again, a particular case of a doubly infinite system of lines, and are so connected with the modern theories of congruences and complexes.

The undulatory theory of light led to Fresnel's wave-surface, a surface of the fourth order, by far the most interesting one which had then presented itself. A geometrical property of this surface, that of having tangent planes each touching it along a plane curve (in fact, a circle), gave to Sir W. R. Hamilton the theory of conical refraction. The wave surface is now regarded in geometry as a particular case of Kummer's quartic surface, with sixteen conical points and sixteen singular tangent planes.

The Extent of Mathematics.

It is difficult to give an idea of the vast extent of modern mathematics. This word "extent" is not the right one; I mean extent crowded with beautiful detail—not an extent of mere uniformity such as an objectless plain, but of a tract of beautiful country seen at first in the distance, but which will bear to be rambled through and studied in every detail of hillside and valley, stream, rock, wood, and flower. But, as for anything else, so for a mathematical theory—beauty can be perceived, but not explained. As for mere extent, I can perhaps best illustrate this by speaking of the dates at which some of the great extensions have been made in several branches of mathematical science.

In conclusion, I would say that mathematics have steadily advanced from the time of the Greek geometers. Nothing is lost or wasted; the achievements of Euclid, Archimedes, and Appollonius are as admirable now as they were in their own days. Descartes' method of co-ordinates is a possession for ever. But mathematics have never been cultivated more zealously and diligently, or with greater success, than in this century—in the last half of it, or at the present time; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics we may most confidently say:—

Yet I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns.

MR. WEBB'S COMPOUND LOCOMOTIVE.

He would, we think (says the *Engineer*), be a rash man who without hesitation condemned the system as thoroughly bad, or praised it as completely good. No one possesses as yet the data necessary to enable a final conclusion to be formed as the result of experimental evidence; and so far we must suspend our judgment until events develop themselves. But there are certain aspects of the questions involved which not only admit of being discussed, but which really demand discussion at this moment. Thus, for example, Mr. Webb has now, or soon will have, a dozen of his engines at work, and on the results obtained with these a great deal may depend. In such a case as this the inventor is by the nature of things practically debarred from giving evidence. No disrespect will be meant, but nothing which Mr. Webb could say regarding his engines will be accepted as conclusive unless he can support his statements with well authenticated facts, and such facts must also be pertinent—a point very frequently overlooked by inventors. Thus, for example, Mr. Webb may state that his compound engines are burning but 26·6lb., as compared with 34·6lb. with non-compound engines on the London and North-Western Railway. Now, we have here an example of what may be termed the non-pertinent statement. In other words, such a fact has by itself little to do with the question at issue, which is, is the compound locomotive more economical than the non-compound? The railway world at large does not care a great deal if one engine on the London and North Western Railway is more economical than another engine on the same railway system; but it does want to know very much if the compound type of locomotive is more economical than any other type. To put this more clearly, we may say that while we accept Mr. Webb's statement that the compound engine is burning but 26·6lb. of coal per train mile, or about three-fourths of the coal needed by other Crewe engines, we can add that there are non-compound locomotives on other lines, working under almost the same conditions of load, speed, and gradients, which are getting on perfectly well with about the same quantity of coal that the compound engine is burning. Here, then, if we compare the compound engine with one type of non-compound, we find that it is very much more economical; if with another, we find that it possesses no advantage at all. But this is not all. No comparison of the kind can be complete which omits a statement of the quality of the coal burned. If Mr. Webb is using cheap coal, and his non-compound rival dear coal, then the comparison may, after all, be very much in favour of Mr. Webb. There is yet another point for consideration: How does Mr. Webb arrive at his results? Does he trust his drivers, or has he an independent inspector riding constantly on each of the new engines, and reporting on its performance? It is obvious that the men driving these engines have the greatest possible temptation to make them do well, and there are more ways than one, as every locomotive superintendent knows, of making an engine give a high duty. Of course we do not assert that due care has not been taken to get accurate results; but neither Mr. Webb nor any one else in his position can expect those to whom his invention appeals to be satisfied with anything short of a clear and definite statement of the precautions taken to obtain unimpeachable figures. Mr. Webb himself would be satisfied with nothing less as regards the invention of any other railway engineer; and we have no doubt but that in due time he will supply all that is wanted; but up to the present this kind of information is lacking, and judgment must therefore be suspended.

The whole system may be dealt with on a theoretical basis. Why, we may ask, should a compound be more economical than a non-compound engine? It is not necessary, fortunately, to enter into any discussion here of the merits of the compound system in preventing cylinder condensation and such like. The whole theory lies in a nutshell. An ordinary locomotive exhausts steam at a comparatively high pressure when it is hard worked. Thus an engine with 18in. cylinders, 24in. stroke, will deliver at each end of each stroke about 3·67 cubic feet of steam into the chimney, and this steam will have a total pressure, according to the speed of the engine and the point of cut-off, of from, say 100lb. on the square inch down. It is not likely that it will fall much below 25lb. above the atmosphere when the train is fairly heavy, unless on a falling gradient. We have here, then, absolutely wasted nearly 3·75 cubic feet of steam per stroke. If the cylinder were augmented in length, then it is clear that the steam might be permitted to follow the piston further, and so falling to a lower pressure give out a great deal of power. In other words, compounding a locomotive means nothing more than augmenting the cylinder capacity. It may be said that it is not quite a fair statement of the case, because in some instances the cylinder capacity has remained unaltered. This is only an apparent exception, as a smaller weight of steam is used at each revolution of the driving wheels in such a compound engine as that of Henschel with two cylinders only. Thus it is clear that the cylinder capacity is virtually augmented; in other cases it is actually increased. But precisely the same effect may be produced up to a certain point by simply putting in larger cylinders. Thus, let us suppose that an engine with a given boiler power has cylinders 16in. diameter and 24in. stroke. If, now, these are removed, and a pair of 18in. cylinders put in, the effect will be that of compounding. The engine can be worked much more expansively than it was before. The experiment has been actually tried, and with such unsatisfactory results that the cylinders have usually been lined up again; but the reason was usually that the load was increased at the same time that the cylinders were enlarged, and the engine performed worse than ever, because the boiler could not keep steam for the extra load behind it. If such experiments had had fair play, there would perhaps have been a saving of fuel. If not, then the prospects of the compound system are bad.

It must never be forgotten that the conditions under which a locomotive operates are of paramount importance in this connection. As a rule, passenger locomotives of the best type are so designed and loaded that very little work indeed is left in the steam as it escapes up the chimney. A glance at the diagrams taken from such engines will show that at high speeds expansion cannot be pushed further with advantage. The case is different with goods engines. We constantly find them hauling trains at slow speeds and working nearly in full gear. The power wasted up the chimney is then very great indeed. To such engines at such times more cylinder capacity would be invaluable. But for reasons very well understood, it is highly desirable that the increased capacity should be supplied rather by augmenting the number of cylinders than by increasing their diameter. Much is to be hoped, we think, from compounding goods engines. With them there are chances of saving fuel which have no existence in the case of the passenger engine. We may call attention here to the noteworthy fact, that while passenger engines exert daily a greater horse-power than goods engines, they burn much less coal per train mile, and the reason is that the passenger engine is seldom or never run in full gear, while the goods engine does the greater part of its work with steam admitted for at least 50 or 60 per cent. of the stroke. By augumenting cylinder capacity this would be avoided. The use of bigger cylinders than those now in use would do no good, because they also would be worked in full gear. The great advantage of the compound system is that the driver may do what he pleases, he cannot help work his steam expansively; and in this, much more than in the principle of compounding, will be found, we believe, the secret of all the economy that can be realised by compounding a passenger locomotive engine at all events.

MEAT AS FOOD.

The value of meat as food is due in a degree to its heat-producing properties, though in this respect it is surpassed by fatty and amyloid substances. It is as a tissue-building material, and as an excitant of assimilative changes in the tissues, both with regard to itself and to non-nitrogenous foods, that it is most useful. It is stimulant as well as nutritive, and it therefore holds a deservedly high place in the daily dietary. Experiment has shown that three-quarters of a pound of lean meat fairly represents the quantity per diem which, taken with other less nitrogenous matter, suffices to maintain a person of average size and weight in a normal state of health. Some there are who largely exceed this standard, eating freely of meat at every meal, and living all the time quiet, sedentary lives. Such carnivorous feeders sooner or later pay a penalty by suffering attacks of gout or other disorders of indulgence. But it is equally important to note that many others, especially women, healthy in all points but for their innutrition, are apt to err as far on the other side. Thus one meets with people who consume about a pound of butcher's meat in a week, or not even that. This fact has been fully brought out by Dr. Graily Hewitt, in his address to the Obstetrical Section at the recent meeting of the British Medical Association. He has likewise with much probability assigned this defect of diet as the chief cause of that general "weakness" which is so common among the antecedents of uterine displacement. The experience of many practitioners will confirm his observation. Different causes are at work to produce this kind of underfeeding—too rigid domestic economy, theoretical prejudicies, the fastidious disinclination for food which comes of a languid in-door life without sufficient bodily exercise, tight lacing perhaps, and many more. These difficulties are all more or less removable, unless, indeed, where absolute poverty forms the impediment. No effort should be spared to remove them. The advantages derived from a diet containing a fair amount of solid animal food could not be obtained from a purely vegetable or milk regimen without either unnecessarily burdening the digestive system with much surplus material, or, on the other hand, requiring such revolutionary changes as to quantity and quality of food and times of eating as would probably altogether prevent its general adoption, even were that desirable, into household management. In our opinion, such changes are not desirable, as being inadequate to secure their purpose.—*Lancet.*

THE MAGNETOPHONE.

The following account of an experiment on the effect of a rotating perforated disc on the magnetic field is from the pen of Prof. H. S. Carhart, of Evanston, Illinois, who calls the instrument, the magnetophone:—The experiments of Bell, Preece, and others, on the radiophone, suggested the possibility of interrupting, or at least periodically modifying, the lines of force proceeding from the poles of a magnet by means of a disc of sheet iron, perforated with a series of equidistant holes, and rotated so that the holes should pass directly in front of the magnetic pole. It is well known that the armature placed on the poles of a permanent magnet diminishes the strength of the external field of force by furnishing superior facilities for the formation of polarised chains of particles from pole to pole. This is the case even when the armature does not touch the poles, but is in close proximity to them. If a piece of sheet-iron be placed over the poles of a magnet without touching, and magnetic curves be developed on paper above the iron, they will be found to exhibit less intense and less sharply defined magnetic action than when the sheet-iron is removed. If, however, a small hole be drilled directly over each magnetic pole, the screening action of the sheet-iron is modified in much the same way as when a hole is made in a screen opaque to light, for the developed curves show distinctly the outline of the holes. If, therefore, the sheet-iron in the form of a circular plate, pierced with a number of holes, be rapidly rotated between the poles of a magnet and small induction bobbins, the action of the magnet on the core of the bobbins will be periodically modified, because of the passing holes, and hence induced currents will flow through a circuit including the bobbin. A disc of sheet-iron was pierced with two circles of ¼in. holes concentric with the disc, the number of holes in the two circles being 32 and 64 respectively. On one side of the disc was placed a horsesho magnet, with its poles very near the rows of hol the same champion of the theory in one of the city churches. He holds that the doctrine of direct descent of organic species from pre-existent species, throughout the geological record, is proved and certain. The process is from simple to complex forms of life. We are approaching a complete genealogy of all existing animals, including man. Facts confirm our belief that however constant species may appear to us now, they have been at some time variable.

On the grand question of glacial action, numerous papers were read, accompanied by discussion, in which the leading geologists of the country took part.

WATER POWER FOR ELECTRIC LIGHTING PURPOSES.

THE Brush Electric Lighting Company, of Rochester, New York, have erected a generating station on the west bank of the Genesee River, at what are called the "Lower Falls," in the city of Rochester. It is the intention of the company to utilise the water power of the river to drive turbines, which will be connected by pulleys and belts to a long line of overhead countershafting, from which the dynamos will be driven by belting. The following description of these works is extracted from the *Milling World*:—The works consist of a brick building or house, 100ft. long by 50ft. wide, and one story high, resting upon and supported by substantial substructural walls and piers of stone and brick, of various heights and forms and substantially based upon prepared foundations at various levels in the solid rock. The superstructure is spanned across its width at the base of the roof with nine trussed girders, which support the roof and the line shafting with its leading wooden-rimmed band wheel, 5ft. diameter by 4ft. 8in. face, and 18 pairs of fast and loose wood-rimmed pulleys, 42in. diameter by 13in. face each, making 360 revolutions per minute, and connecting by 12in. belts with 18 dynamo machines arranged upon the floor near either side of the building, giving them 756 revolutions per minute, at an expense of 40 horse-power each, making a total of 720 horse-power, supporting 720 lights, equal to 40 lights per machine, or one light per horse-power. The magnitude of the lights is not stated. The fast and loose pulleys which drive the dynamos were furnished by the Taper Sleeve Pulley Works of Erie, Pa., and they are so constructed and arranged that by one single and gradual movement of a double-headed oscillating cam, in connection with a belt shifter, the loose pulley, which hangs on a hollow independent bearing concentric with and surrounding the shaft without contact therewith, is thrown into gear and set in motion, so that as the cam is continuously moved forward through the extent of its parallel arc, which holds the loose pulley in gear, the belt is shifted on to it, when, by a little further movement of the cam, its inclined part at the rear end disengages the clutch, and the loose pulley, together with the belt and the actuated machines, cease moving and remain idle, until the cam is moved in the reverse direction, setting the idler in motion, shifting the belt into working position, and setting the machine in motion, when by the inclined part of the opposite end of the cam from that aforementioned the clutch is disengaged and the idler is again at rest, out of contact with any of the running parts. It is in contemplation to add nine more electric machines in this same building, to be driven by the same power, should time and circumstance demand it, making twenty-seven in all, producing 1,080 lights and requiring 1,080 horse-power. The power is to be obtained by the use of two Victor turbine water wheels, 20in. in diameter, made by the Stilwell and Bierce Mfg. Co., Dayton, Ohio. This wheel is noted for the extraordinary power developed by it, in proportion to its diameter, while at the same time the percentage of power in proportion to water expended (according to tests made at the Holyoke testing flume) ranks it among the highest and best. Another advantage possessed by this wheel is that its comparatively small diameter for a given power causes it to revolve so rapidly as to make a considerable saving in the cost of shafting and gearing.

The situation and surroundings of the water wheels and their appurtenances in this case are indeed unique and extraordinary, and indicate a perspicacity of discernment, acuteness of conception, boldness of design, and thoroughness of execution on the part of the projector, that stamps him at once as eminently qualified to place and execute a work like this, environed as it is by great natural obstacles and serious practical difficulties. To make a proper place for the flume or forebay, an open recess or bay was cut into the upper rock bank about 32ft. horizontal depth by 20ft. wide and 46ft. perpendicular depth, down to a level with the bottom of the head race. The bottom of this bay is about 45ft. below the floor of the superstructure, and extends under it about 28ft. From the bottom of this recess at its back side is a shaft about 12ft. square, sunk perpendicularly into the rock to a depth of about 90ft., to a point some 4ft. or 5ft. below the surface of the backwater from the river below the falls, which are nearly 100ft. high. From this shaft a culvert extending about 35ft. in height from the bottom of the shaft is cut through the rock out to the river. Between the top of this opening or doorway, and the bottom of the race and forebay, is about 55ft. vertical thickness of rock.

On the bottom of the recess in the rock, and partly over the shaft therein, is the flume, containing two U-shaped iron forebays, 7ft. high, opening toward the head race, and from the bottom of which are suspended two iron stand pipes, 76ft. and 10in. long by 42½in. in diameter, their upper ends opening into the forebays to receive water to supply the wheels. At one side of each stand pipe, and connected thereto with a short cylindrical tube, is an iron wheel case, with a draught tube attached to its bottom, and extending some 10ft. downward, and entering the backwater. Besides the support to the stand pipes by their connection with the iron forebays, they and the wheel cases are supported at their bottoms by iron beams. The turbines are placed in the wheel cases, and each one has about 58ft. of steel shafting, 3⅜in. in diameter, coupled to it and supported by bracket bearings projecting from the stand pipe. Each of said shafts has on it, near its top end, a spur pinion 21¾in. in diameter by 17in. face, 17 teeth, 4in. pitch, machine dressed. These gear into a core spur wheel 69¼in. in diameter, having 54 wooden cogs, and which is hung on near the bottom of a steel countershaft 6in. in diameter and 60ft. long, on which, near its top end, is a bevel wheel 88in. in diameter, 18in. face, 55 teeth, 5in. pitch, gearing into a core bevel wheel, 99·6in. in diameter, with 56 wooden cogs, 18in. wide.

This wheel is on a short, horizontal shaft, 6in. in diameter, having on its farther end, beneath the floor of the building, an iron spider carrying a wooden rim band wheel, 10ft. in diameter by 4ft. 8in. face, carrying a rubber belt 4ft. 6in. wide by ⅜in. thick, which connects with the heretofore described 5ft. leading band wheel on the main line of shafting above, and drives them.

The turbines operate under 94ft. head of water, including the 10ft. draught tubes, and are estimated to make 582 revolutions per minute, and develop 572 horse-power each, which, combined, equals 1,144 horse-power. The counter upright shaft makes 183·22 revolutions per minute, the counter horizontal shaft, with the 10ft. band wheel, 179·95 revolutions per minute, the main line shaft about 359·9 per minute, and the electro-dynamos 755·79 revolutions per minute.

TWIST DRILLS AND MACHINES FOR GRINDING THEM.[*]

By PROF. J. E. SWEET.

I HAVE recently had the pleasure of seing two different, thoroughly well studied, neatly designed, and spendidly built machines for grinding twist drills. They do not operate on the same principle, nor produce the same results, neither are they the only machines that have been built for the same purpose. The earliest machine brought to my notice with which it was proposed to grind twist drills on scientific principles, was the Van Haagen machine, built in '73 or '74. At the Centennial a machine of George Richards' design was shown in the exhibit of D. B. Whitney, for which the claim was made that it was nearer correct in its result, than the Van Haagen machine. One of the two machines first mentioned, the Sellers, it is claimed produces the correct form, but whether the result is like either that produced by that of the Van Haagen or Richards machine, I do not know. It is decidedly different in its manner of working, and the device for holding the drill is unquestionably better. The other new machine, built by the Pratt and Whitney Company, differs from all the others, not only in design and method of holding the drill, but also in the shape of the point and cutting edge given the drill. I do not know whether it is claimed that the point and edge are theoretically correct, but according to my notion the best form is approached.' Let it be understood that I intend to say nothing except in praise of both the Sellers and Pratt and Whitney machines, believing that both produce exactly what their designers intended they should produce, and, too, what each believed to be the best possible form for the work to be done.

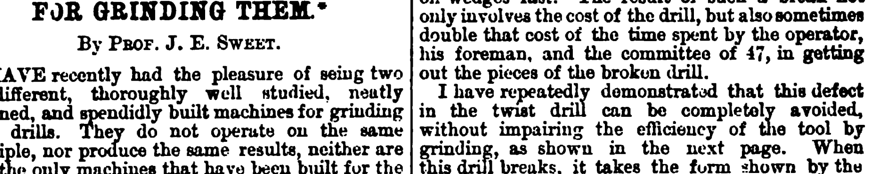


FIG 1 FIG 2 FIG 3 FIG. 4 FIG 5

If the cutting edges of a straight lip twist drill run in radial lines completely to the centre of the drill, then the case would be simple, but being neither radial nor running to the centre complicates the case. In drills of different sizes, and often in drills of the same size, and in different parts of the same drill, the conditions vary, so that there must be some sort of a compromise. Any method of grinding that produces a curved surface on each lip produces something approaching a cone at the point, and as a true cone would not work at all, as it would act as a centre and not cut its way into the metal, so the form most nearly approaching the cone must be worse for that part of the drill, and in that respect the Pratt and Whitney method leaves a bevel along the cutting edge of each lip, and by that means leaves the point more nearly wedge-shape than the method of grinding a full curved surface. My own idea is that, so far as the cutting edge of the lip is concerned, if the grinding starts from the edge with a proper degree of clearance, it makes no difference whether the following surface is straight, concave, or convex, provided the straight or convex surface does not leave a point to drag in the hole. Let the Figures 1, 2, and 3 represent the developed surface of one lip of a twist drill. Fig. 1 fairly represents the drill as sent out by the makers, and as left by the scientific grinding machine; Fig. 2 a shape they sometimes get into when ground by hand, and Fig. 3 the form they would assume if ground a straight bevel, and which shows that the back corner would prevent the drill from cutting. So far as the cutting edge is concerned, I believe all would cut equally well, but in the ones shown in Figs. 1 and 2 the points will be conical, and the one in Fig. 3 wedge-shape. Any firm using twist drills exclusively finds, I think, that it involves quite an item of expense, and that the cost is as much attributable to breakage as to actual wear. A large proportion of the breakage expense comes from the drill commencing to break at the bottom of a deep hole, and being shattered all the way up to the top. Why a twist drill breaks in this peculiar manner is easily shown when the direction of the fracture is observed.

When a drill, as ground by the makers, breaks by being forced too hard, the break invariably takes place as shown at A, Fig. 4. The piece broken off wedges fast, and unless the machine is instantly stopped a succession of breaks takes place, as shown at B, C, D, &c., because each piece broken off wedges fast. The result of such a break not only involves the cost of the drill, but also sometimes double that cost of the time spent by the operator, his foreman, and the committee of 47, in getting out the pieces of the broken drill.

I have repeatedly demonstrated that this defect in the twist drill can be completely avoided, without impairing the efficiency of the tool by grinding, as shown in the next page. When this drill breaks, it takes the form shown by the line E, Fig. 5, and the piece does not wedge, leaving the drill free to rotate. I have also demonstrated by actual trial that it is impossible to get any one, young or old, skilled or unskilled, to so grind a drill, however many times he may be shown or made to acknowledge the superiority of the method. I shall probably continue to believe this to be the best way to grind a twist drill until I meet with some man who can get as much hole in the same piece of metal, with the same expenditure of power, time, and drill, ground in some other way, as I can with one ground in this style. It is possible that that if a twist drill grinding machine were available for grinding in this shape (and it would seem that the problem would be simplified by adopting this form), then people might be induced to adopt it.

Twist drills, however ground, are a money-saving investment, though it is not infrequent to find mechanics raise powerful imaginary objections to them. One man says, "You can't ream out a

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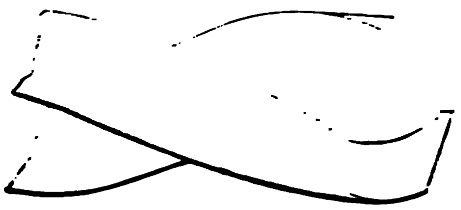
[*] From the *American Machinist.*

[illegible] Another [illegible] and another [illegible] [illegible]

[illegible]



[illegible]

DOMESTIC HINTS.

Hard Wood Floors.—[illegible]

Feather [illegible]

[illegible]

SCIENTIFIC NEWS.

T[illegible]

[illegible]

[illegible]

[illegible] the late C. Darwin, [illegible] translated by Mr. D'Arcy [illegible]

[illegible] Edinburgh has now taken [illegible] quarry at Granton having [illegible] and the necessary [illegible] The surplus funds derived from [illegible] Fisheries Exhibition in Edinburgh have [illegible] supplemented by an anonymous donation [illegible] and the Station Committee has just [illegible] with its work, which [illegible] undertake a scientific exploration [illegible] of the Firth of Forth and the adjacent parts of the North Sea: and to establish a marine station for biological investigation and research." It is hoped that the institution may be in full working order by March or April next.

By the kindness of the trustees of the Gilchrist Fund, the committee of the Royal Victoria Coffee Hall have been able to arrange for the delivery of six "Penny Science Lectures." The lectures will be as follows:—October 2 and 9, "Ice, Water, and Steam," by Mr. W. Lant Carpenter; October 16, "Life," by Mr. P. H. Carpenter; October 23, "Comets," by Mr. E. B. Knobel; October 30, "The Rights and Feelings of an Animal," by Mr. C. A. V. Conybeare; and November 6, "Food and Feeding," by Dr. B. W. Richardson. The lectures will be illustrated with the oxy-hydrogen lantern.

The accounts of the experiments with electrical trams in Paris are misleading in one particular. There never was any doubt that engineers could do their part of the work; but there is much reason to doubt whether "the estimated cost is one-half that of horse trams," or, being so, whether some mistake has not been made by the estimator. M. Geraldy has already pointed out that the expense of driving cars fitted up with two tons and a half of accumulators is seriously objectionable."

Another matter concerning which misleading statements are made, is the transmission of power by electricity. Here, again, there has never been any doubt that power could be transmitted over considerable distances by means of electricity; but when we find it stated that M. Marcel Deprez obtained a return of 62 per cent. we ask for proof. The power of a waterfall about [illegible] miles from Grenoble was made to produce a motive effect equal to seven horse-power (some accounts give eight horse-power), which was utilised in working various machines; but no definite information is afforded as to the actual amount of power put into the line at the other end.

The International Society of Electricians has been founded in Paris under the presidency of the Minister of Posts and Telegraphs. The annual meeting will be held in March or April, and the ordinary meetings on the first Wednesday in each month from October to June. The temporary offices are at 99, Rue de Grenelle, Paris.

The meeting of the Electrical Units Conference in Paris has been postponed until April 2, 1884.

Baron Nordenskjold's expedition in the *Sophia* arrived at Julianshaab on June 17, and proceeded to Ivigtuk for coals. The voyage to North Greenland was resumed on June 26.

Mr. Webster Gillett, of Flushing, Long Island, is credited with the invention of a telephone by means of which conversation can be carried on between points 2,600 miles apart. The inventor's object, however, is to construct a telephone capable of use with the Atlantic cables. The device appears to consist of a tin-plate disc 13in. in diameter, from the centre of which projects a funnel-shaped resonator. On the opposite side of the disc there are ten "deviating points" held in position by rubber arms. These deviating points are needles which pass through rubber cushions into cylinders containing granulated carbon. These ten points are connected up with ten batteries, and the same number of induction coils, and a plug switch puts one or more, or all, the points in the circuit. Mr. Gillett is said to claim that his ten points, coils, and batteries have about six times the power of one battery; but the chief feature of his invention is the rubber cushions through which the needles penetrate to make contact with the granulated carbon.

A series of "Popular Evening Classes" has been arranged for the ensuing session in connection with Anderson's College, Glasgow. The lectures will be on "Geology," by J. C. Christie; "Electricity and Magnetism," by Prof. Jas. Blyth, M.A.; "Anatomy and Physiology," by Prof. A. M. Buchanan, M.A.; "Music," by Colin Brown; and "Chemistry," by Prof. W. Dittmar. The fee for each course of 25 lectures is 2s. 6d., and that includes the use of the library and reading room! The lectures are delivered at 8 o'clock on the evenings specified in the syllabus.

Mr. Fletcher, of Warrington, has recently added to his numerous inventions in connection with the combustion of gas a special form of furnace bar, which can be made up into furnaces of almost any size and shape. Where a blast of air is available, a special attachment is supplied which will enable 1,000 cubic feet of gas to be burned per square foot of burner surface per hour, equal to, say, 40lb. to 50lb. of coal per square foot of grate. With ordinary day pressure of gas, the bars burn about 100 cubic feet per square foot.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

OPTICAL MATTERS.

[21821.]—Our friend "Bow" discharges his arrows in so many directions that he must not be surprised if some of us that he has smitten try to turn him into a target. As regards spherical chromatism, I cannot say whether or not I am the first to touch upon it. Like "Bow," I should very much rejoice to meet with a book in which it is thoroughly investigated. Cannot our friend give us something about Airy's work in this branch of optical mathematics?

He is probably right in assuming that "mathematicians tacitly assumed that altering the character of curves would seriously affect the balance of spherical aberration, and would produce but small effect on colour." But, unfortunately, it is this neglect of small matters which makes all the difference between a "good" o.g. and a "best" one. "Bow" must be aware that the connection between sp. and chr. aberrations is as close as that between the string and the bow, and what alters one affects the other also, although it may not be to the same extent.

"Bow" then goes on to say, "Whereas it would seem that having destroyed sp. ab. by proper ratios of radii, we may sometimes play considerable tricks with the nature of the curve." It does not seem so at all. The chief part of chromatic error is removed by a proper ratio of radii, and then the surfaces are worked so as to remove the spherical and residual chromatic errors as much as possible. If we are to balance sp. ab. by curves calculated on the basis of spherical surfaces, which is, so far as I know, the only way in which the problem can be successfully dealt with, there is not much liberty for playing tricks with the nature of the curves. Of course, it may be possible for a clever artist to work such surfaces not exactly spherical, and still get the combination to give good definition; but could anyone, even the artist himself, say how the final surfaces differed from sphericity?

This may be regarded as a sort of optical legerdemain; but I have laboured in my essay to show that it is, or at least may be made, part of a regular system of surface alteration. Let us look at it in the light of reflection. A parabolic speculum gives no aberration. Why? Because its surface is of such a nature as to send all the rays to one point. Just so with the object-glass: each of its surfaces might (I do not say can) be so fashioned as to direct its own incident rays to one particular focus. There would then be no inherent refractive or spherical aberration, and if spherical error be not introduced, and consequently no positive and negative errors, then I contend that the residual chromatic errors must also be considerably lessened. Can "Bow" show it to be otherwise?

The really difficult matter connected with the successful application of mathematics to the object-glass is to find what relation of foci, or—which comes to the same thing—what ratio of radii will best correct the chromatic error. I have, as yet, met with no rule which will give this satisfactorily. Ordinarily it is said that the foci should be as the dispersive powers; and this, perhaps, might not be far out, if we could get to know exactly what the dispersive power of a substance is.

Dr. Hastings has developed a new theory of focal proportion which is said to give a very satisfactory result. I have no knowledge of it at present; but I trust some American friend will copy all or part of the article and send it to these columns. Our esteemed contributor Mr. J. A. Brashear has kindly sent me two copies of the *Sidereal Messenger*, each containing an article by Dr. Hastings: from the first of these I make the following extract. After alluding to the determination of the refractive indices, Dr. Hastings says:—

"With the data thus acquired, the curves for a four-inch objective from the two glasses studied were calculated, such that the spherical aberration for rays of mean wave length should vanish, and under the hypothesis that the sum of the squares of the chromatic aberration for other wave lengths, weighted according to their respective luminous intensities, should be a minimum. This was the naturally suggested criterion for determining the most advantageous value for the dispersive ratio, and, although it did not differ very greatly from the method chosen by Fraunhofer without leading to a successful issue, it was hoped that the difference would be sufficient to correct his error. The objective was carefully constructed according to these curves, though it was first found necessary to improve the form of the spherometer so as to greatly increase its delicacy. The experiment proved a failure. Though the telescope was free from spherical aberration, thus proving the workmanship good, the colour correction was decidedly too small. A careful remeasurement of the surfaces, and a repetition of the computations demonstrated that the theory was certainly at fault.

"A reconsideration of the whole subject gave rise to quite a different method of determining the most appropriate value for the dispersive ratio. By it the question of limiting extent of chromatic aberration was not considered at all, but only a condition as to the amount of light energy sent very near the geometrical focal image of a distant point. This theory (*American Journal of Science*, Vol. XI. April, 1878), after having been once formulated, was so satisfactory that there was no doubt as to its success even before testing it; but, as what follows will show, that did not lead to any neglect of rigorous tests."

I trust some of our friends who have access to the above journal will let us have particulars of a theory which can give so satisfactory a result. All who have given any considerable amount of attention to the study of optical chromatics most have wished to see it dealt with in a more satisfactory manner, and this Dr. Hastings appears to have accomplished.

Orderic Vital.

ARCHIMEDES.

[21822.]—In the "E. M." of August 17, 1883, I notice a letter, No. 21706, from Mr. B. J. Hopkins, relative to an unusual appearance seen by him May 19, 1883, upon the floor of the lunar crater, Archimedes.

It will, perhaps, be satisfactory to Mr. Hopkins and to other readers of your paper who are students of selenography, to know that his statement descriptive of the remarkable phenomenon to which he has called attention, has been subsequently confirmed by a careful observation here, without any knowledge of the same having been previously seen.

On the evening of the 14th of June, 1883, while sweeping with a 4in. ach. along the abrupt declivity of the lunar Apennines, my attention was suddenly arrested by the unusual distinctness of the bands upon the floor of Archimedes, a crater which I have, during the last ten years frequently and carefully observed under various shades of illumination, so that I could scarcely be deceived as to what I saw, and have several times subsequently seen, perhaps more distinctly than your correspondent of Dalston, owing to the clearness of the atmosphere in this part of the States. The description he has given, however, strictly agrees with what I have observed.

It is to be hoped that this interesting object will be carefully scrutinised by the aid of the highest optical power that can be brought to bear upon it, so as to elicit, if possible, something as to the cause of its present unusual appearance.

F. S. Davenport.

Jerseyville, Illinois, United States,
September 1.

A PENNY WATER CLEANER.

[21823.]—There seems to be, just now, a scare, partly natural and partly artificial, about the wholesomeness of water, in view of a dreaded invasion of cholera. Nobody knows, on direct evidence, whether cholera or fever be due to germs. The evidence is indirect. Such illnesses, or rather their causes, may be brought, like thistledown, on the wind, or like ringworm, they may be brought by first or second contact.

The source of ill multiplies quickly. It is therefore like yeast. It is stopped by the heat of boiling water. So is all animal and plant life.

The balance of evidence now, I suppose, is that catchable diseases are due to living germs.

Now it may be taken for granted that one and the same living thing, whether plant or animal, cannot live long both when wholly and permanently immersed in water, and when wholly and permanently immersed in air.

If there be a germ whose habitat is water, and if it be exposed to the air, it faints and then dies, and is straightway burnt up. You will guess now that the moral of the penny purifier is aëration.

Subtle as the disease germs in water may be, they shall not escape the touch of the oxygen.

Therefore, in finally purifying water by filtration, let it run over abundance of surface. And, while so running, let it be freely exposed to the air. A porous filter without aëration—a mechanical filter—is of some use. You can get rid of dead cats, mice, flies, and all things greater in least diameter than the least diameter of the pores of the filter, through which pores they try to pass. But what would be the use of keeping a mass of putrid matter at the top of your filter? You do not thus get rid of germs, nor of organic matter, which is the hot-bed of germs.

In the water which has passed through some of the most esteemed filters, I have found "moving organisms" at least as large as the vinegar worm. I do not say that these came through the filter: they may have reached the water after it was filtered, in one or other stage of development. They were undoubtedly bred in the filtered water. Because, although the filter may have removed the poultry, it did not remove the grain upon which chickens feed, nor probably the eggs from which they spring. I, for my part, would no more hesitate to drink such water than I would hesitate to drink water from a brook in which there were trout or tadpoles. Nor would I more refuse to drink of water in which there were dead organic matter than I would refuse soup, or milk, or beer.

As to your cisterns, keep them covered, but not too closely. Canvas is better than wood. Light is good. As to the cleansing of cisterns, a very little arithmetic will prove that if no dirt reaches the cistern from the air, the average purity of the water which is drawn from the cistern is the same as that of the water which enters the cistern. If you clean out a properly covered cistern daily you gain only in the benefit you derive from the physical exercise. At all longer intervals, such cleansing is folly. This is of course assuming that the water, as given to us from the companies, is good. So it is—excellent! London is the only capital in Europe where one can rely upon getting a glass of fair water from the tap.

Then what is the use of filtering the cistern water? Because contagion may exist in or near the house.

And so, to come to the penny filter. Take a flower-pot and a brick. You can get three flower-pots for a penny—also three bricks for a penny. However, let us say a flowerpot and a brick for a penny. Break the bottom out of the flowerpot in such a way as to leave edge enough to hold up half a brickbat. Let one corner of the half brickbat stand out through the bottom hole. Break up the rest of the brick into bits about as big as a quarter of a walnut. Throw them into the pot. Soak the whole over night in a pail of water, and let it drain.

Let the water you want to clean drop upon the middle of the chips of brick. After a few hours the water which drops from the bottom will be wholesome and fair water. Most filters pretend to purify water mechanically. They clarify rather than purify. Others depend upon some curious property of the medium, like animal charcoal. Such cunning matters, have to be frequently reviewed. The purifier I suggest combines a rather coarse filtration with an effective aëration and something of a specific chemical action as well. But its beauty is its cheapness. Only one penny, and as good as any other.

Fredk. Guthrie.

Science Schools, S. Kensington.

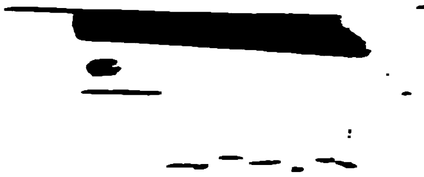
ORNAMENTAL TURNING AND THE PROPOSED STANDARD MANDREL.

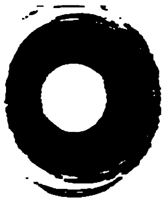
[21824.]—In reply to letter 21785, I have much pleasure in presenting the engravings below, as reproduced from p. 64, of Amateur Mechanical Society's *Journal* (No. 25).

Fig. A represents a longitudinal section of the standard mandrel-nose, with its steel collar and the portion of lathe-head which carries it.

Fig. B represents the cross sections of the mandrel-nose. The outer circle represents the cross section of the cylinder base, which should be 1·050in. in diameter. The next circle represents a cross section of the full nose before it is threaded out, and should be 1in. in diameter. The excentric circle represents a cross section of the nose after it has been threaded out, and should be ·9in. in diameter. This section of the threaded nose is practically a circle, though not exactly so. Its excentricity is half the depth of the thread, and its figure will always be the same, whatever part of the nose is cut through; but, as the section traverses the screw this circle will rotate upon its own centre. It shows the extent to which the mandrel-nose is weakened at its base by the present practice of turning out the thread. In the mandrel here represented this turning out of the thread merely to its bottom would diminish the cross-section area from ·5106 to ·3770 square inch. The third concentric circle represents the outline of the stem of the screwed nose, and should be ·8in. in diameter. The innermost circle shows the bore of the mandrel, and should be ·4in. in diameter.

Fig. C represents an enlarged cross section of the





[illegible]

[illegible] the extra space [illegible] and the bearers is invaluable [illegible] appliances. The [illegible] on the [illegible] of surplus [illegible]

[illegible] from [illegible] by means of a [illegible] the cylinder [illegible] its margin. [illegible] be turned off [illegible] so as to leave the [illegible] of the end [illegible] from the lathe [illegible] the edge of the inner [illegible] diameter at its [illegible]

[illegible] to blue, and [illegible] to straw- [illegible] base, and the thread [illegible] diamond dust [illegible] true and accurate [illegible] the interior of [illegible] When carefully [illegible] in a dark room, [illegible] surface into the eye [illegible] from a fixed mirror, [illegible] in its collar at [illegible] be well fitted, [illegible] and mandrel- [illegible] chuck.

[illegible] a base 2in. in [illegible] and a true hole fully [illegible] so far as to leave [illegible] finished chuck. The [illegible] 1·002in. in [illegible] and the first half of [illegible] enlarged to 1·015in. [illegible] the nose screw, [illegible]—so that its top [illegible] groove the [illegible] may be fully threaded [illegible] if the cutter have [illegible] the thread will be [illegible] as with the external [illegible]. The threads should [illegible] comfortable play [illegible] The first quarter-inch must [illegible] in diameter, [illegible] for the cylinder [illegible] be slightly rounded [illegible] upon the cylinder [illegible] and may allow space [illegible] with the mandrel [illegible] chuck-thread must be [illegible] half a turn of the [illegible] and the chuck face [illegible] face, so as to [illegible]

[illegible] means of holding [illegible] purpose a Whit- [illegible] answer the purpose [illegible] chucks are to be [illegible] mandrel-nose must [illegible] The long angular V thread [illegible] the simpler, [illegible] Ten threads to [illegible] for the slide- [illegible] for the back-centre screws. [illegible] suitable thread- [illegible] size.

[illegible] by the back centre it [illegible] the internal chucks [illegible] so as to deteriorate the truth [illegible] To prevent this such chucks may be [illegible] by a cap chuck screwed on outside [illegible] By this all chucks whose base is not larger than the stem of the mandrel-nose may be [illegible] fixed, while those of larger size may be held by steady-pins, or bayonet catches, between the back of the internal chuck base and the top or exterior of the cap chuck. The half-turn of a double screw-thread might be made to answer perfectly in fixing these small chucks.

The steel collar should be coned so far as to sit solidly in its position without shifting backwards under pressure from the other centre when drilling or turning heavy work. The larger its longitudinal surface for the support of the mandrel neck the greater its endurance, and the more lightly will it run because of the diminished tendency to deflection in the mandrel.

arm, which in many cases is very useful for carrying wheelwork to co-ordinate the movements of tools, &c., with the rotation of the mandrel. If not required for this purpose, it serves to give fixity to the collar in which the mandrel rotates and traverses.

The question as to how a working mechanic may test his gauges is one to which a very satisfactory answer may, owing to the munificence of Sir Joseph Whitworth, now be given. On application to the Standards office at the Board of Trade, Whitehall, a grand series of most accurate gauges may be used by any intelligent working man, and by them any gauges that he may make for himself may be compared and measured to the extreme limits of mechanical accuracy. In measurements of size, Sir Joseph Whitworth has shown that the sense of touch is vastly more accurate than that of sight. **James Edmunds.**

Grafton-street, Bond-street.

THE PRIZE ESSAY ON THE COMPENSATION BALANCE.

(*Concluded from page* 18.)

CHAPTER IV.—It is desirable that a statement be given of the causes of error, and of the Laws that connect the changes of Temperature with the times of oscillation.

[21825.]—THE cause of error of the compensation balance is simply this:—The balance in heat does not approach the centre fast enough to exactly compensate for the loss of the elasticity of the pendulum spring; and that in cold it recedes from the centre too fast, or does not act in a geometrical ratio to exactly compensate for the spring's elongation by heat, or by its increased elastic force in cold.

The Astronomer Royal, by a series of experiments, in the year 1859, tried upon a chronometer with a plain uncompensated brass balance, by which it was shown that there was a uniform decrease of rate for equal increments of temperature measured by a mercurial thermometer, amounting to 6·11 secs. in 24 hours for each degree of Fahrenheit's scale. I believe no other authentic table was ever published in this country, although the celebrated geometrician, Daniel Bernoulli,* conjectured the same in 1747. It was established as a matter of certainty by Berthoud in 1773, with the following result:—One of his marine watches, in passing from 0° to 27° (Réaumur), 32° to 92° (Fah.), it was found that the loss per diem by—

	Seconds.
Expansion of the balance was..............	62
The loss of the spring's elastic force......	312
Elongation of the spring	19
	Min. Sec
Secs ...	393 or 6 33

ROYAL OBSERVATORY, GREENWICH.

Mean Daily Dates of Experimental Chronometer, Charles Frodsham, with a simple Brass Balance—*i.e.*, without Compensation. No. 3148.

1859.	Mean daily rate.	Difference.	Mean temperature.	Difference.	Mean daily variation for one degree of temperature.	Nature of Trial.
	Seconds.	Seconds.	Degrees.	Degrees.	Seconds.	
June 22 to June 25	+ 45·9	...	68·7	...	...	In chronometer room.
Do. 25 to July 2	+ 21·6	24·3	71·4	2·7	...	
July 2 to Do. 6	+ 10·0	11·6	73·2	1·8	6·44	
Do. 6 to Do. 9	− 142·5	152·5	99·3	26·1	5·83	Exposed to heat in the gas stove.
Do. 9 to Do. 16	− 131·9	10·6	97·7	1·6	6·63	
Do. 16 to Do. 23	− 45·2	86·7	83·8	13·9	6·22	
Do. 23 to Do. 30	− 45·4	0·2	83·0	0·8	...	
Do. 30 to August 6	− 101·1	55·7	93·7	10·7	5·20	
August 6 to Do. 13	− 121·0	19·9	95·4	1·7	...	
Do. 13 to Do. 20	− 28·9	92·1	81·8	13·6	6·78	
Do. 20 to Do. 27	+ 11·8	40·7	74·6	7·2	5·66	In chronometer room.
Do. 24 to September 3	+ 54·7	42·9	66·7	7·9	5·44	
September 7 to Do. 10	+ 60·5	5·8	66·4	0·3	...	
Do. 10 to Do. 17	+ 83·9	23·4	62·7	3·7	6·32	
Do. 17 to Do. 24	+ 86·9	3·0	61·9	0·8	...	
Do. 24 to October 1	+ 56·6	30·3	66·7	4·8	6·31	
October 1 to Do. 8	+ 42·7	13·9	69·0	2·3	6·05	
Do. 8 to Do. 15	+ 77·8	35·1	63·3	5·7	6·16	
Do. 15 to Do. 22	+ 103·2	25·4	59·2	4·1	6·20	
Do. 22 to Do. 29	+ 168·0	64·1	48·7	10·5	6·17	
Do. 29 to November 5	+ 168·4	0·4	50·0	1·3	...	Exposed to external air under shed outside north window.
November 5 to Do. 12	+ 180·4	12·0	47·3	2·7	4·44	
Do. 12 to Do. 19	+ 225·2	44·8	40·9	6·4	7·63	
Do. 19 to Do. 26	+ 206·8	18·4	43·8	2·9	6·35	
					103·83	
					$\frac{103·83}{17} = 6·11$	
July 6 to July 9 November 12 to November 19	− 142·5 + 225·3	367·7	99·3 40·9	58·4	*6·30	Mean daily variation for one degree of temperature.

* This difference is caused by the Chronometer having slightly accelerated on its rate.

The same Chronometer, with Compensation applied, gave the following results:—Mean Temperature—88°, 55°, and 32°; Mean Daily Rate—0·0 seconds, 0·0 seconds, and 2·4 seconds losing.

By a study of the table published by the Astronomer Royal (see above), it will be seen that the error is the same with an uncompensated brass balance of 6·11 seconds for every degree of temperature. The change is regular and uniform, passing through heat, cold, and intermediate temperature. Many watch makers are not aware of this great error of 6·11 secs. in 24 hours for every degree of temperature in a watch with an uncompensated balance; and before commencing the adjustments of a chronometer or watch, it will be well to consider the amount of error to be compensated for in a range of temperature of 60°, which is 6¼ minutes; and this error the ordinary compensation balance will correct to within $\frac{1}{10}$th of a second for every degree of temperature. From what has been stated in the former chapter, the error has been shown to be six seconds for 60° of temperature. This error, strictly speaking, does not take place in geometrical progression, nor will the error be so much as one second for the first 10 degrees. As the balance is nearly perfect for 10° of Fahrenheit, provided that it has been accurately adjusted, say at 60° or 90°. Mr. Hartnup, of the Liverpool Observatory, in his report for 1872, has calculated with mathematical precision that for a variation of 30° from the maximum gaining rate of the chronometer the loss will be 2·7 daily, and that this error for a longer range of temperature increases as the square, as per table,—

	Seconds.
For 10°	0·3
For 20°	1·2
For 30°	2·7
For 40°	4·8
For 50°	7·8
For 60°	10·8 or 36 times

the amount of the first error of $\frac{3}{10}$ths of a second for 10°, and so on increasing as the square. But by compensating the balance and dividing the error, the following results will be given by a chronometer timed in 60° range of temperature—

		Seconds.
At 90°	=	0·0
At 60°	×	2·7
At 30°	=	0·0

and on the other hand, the performance of the same chronometer with all the error carried over to the cold would be

		Seconds.
At 60°	=	0·0
At 90°	=	0·0
At 30°	=	6·1

but for all practical purposes, and without going into mathematics, and in this essay it has been my object to avoid all calculations but those obtained from practice alone, I find the error to be rarely less than 3 seconds, so that in 30° of temperature our calculations coincide within $\frac{3}{10}$ths of a second, and in a range of 60° of temperature within $\frac{1}{10}$th of a second, so that the mariner by this method may determine the rate of his chronometer to the greatest exactness, if he will take the trouble to do so; he should always be informed of its error in the three temperatures, or be informed of the temperature his chronometer has its maximum gaining rate, but so long as owners of chronometers allow them to be rated by anyone without the appliances for determining the error, so long will they be kept in strict ignorance of the error of their instruments, thus proving the error to arise through the balance altering its form by the elongation of the arm by heat, and the shortening of the same by cold, carrying with it the rim; thus altering its shape, and not remaining a true or a perfect circle under all changes of temperature. The balance by its proper adjustment can be made to go accurately at two points of the thermometer, but at no other, as seen by the diagram Fig. 1. The arcs of the balance, being composed of brass and steel, are so affected by heat as to curve inwards, carrying the weights upon them nearer to the centre, and thus diminishing the effective diameter of the balance at the same time that the strength of the spring is relaxed, but the centre of gravity of these arcs does not approach or recede from the centre in a straight line. Excess of curvature would cause each arc to take a spiral form; and in some positions the weights approach to or recede from the centre faster than in others. Hence it is found that as the arcs straighten outwards, the amount of movement increases in a greater degree than the spring becomes strengthened. If we connect the centre of gravity of the compensation weight with the junction of the arc with the arm of the balance by the dotted line *d*, we shall see that a decrease of temperature, strengthening the arc, increases the length of this dotted line. The amount of onward motion is, therefore, gradually increased as the temperature falls, and with it the inertia, and the chronometer loses. Drawings have been made, and theories asserted; but I clearly claim, by comparison of the tables given by the Astronomer Royal, that the real error of the ordinary compensation balance is one-tenth part of a second for every degree of temperature, and that the balance of ordinary construction is capable of correcting, and does correct, nine-tenths parts of the whole error of 6¼ minutes for a range of 60° of Fahrenheit's thermometer.

This is the true cause of error that cannot be compensated for without the addition of auxiliary compensation or check-pieces, or by balances of similar construction to Mr. Hartnup's, Mr. E. J. Dent's, or Mr. Kulberg's—the latter, as before stated, apparently combining the principles of the other two gentlemen's inventions; but in a commercial point of view no balance for general good performance has taken the place of the ordinary constructed compensation balance, which, if well and properly adjusted, its error is shown, and takes place as regularly as temperature is indicated by mercury on the scale of a thermometer.

In the works of a chronometer or watch the barrel and fusee revolve so slowly that its motion is quite imperceptible; and through the teeth of this wheel is conveyed the power or force which puts the whole instrument is motion. Again, the escape-wheel revolves with great rapidity, but with so little apparent power, that a very slight opposing pressure will stop it altogether. Loss of power: from failure of the oil, friction, defective compensation, where will be the fine performance then unless the chronometer has had its isochronal and compensational adjustments carried out to all intents and purposes? The chronometer represents itself to be a timekeeper (with an error it is true), which can be tabulated with a degree of accuracy almost to determine the longitude within a mile for any distance.

CONCLUSION.

In writing this Essay on the Compensation Balance and its adjustments, it has been my object to adhere strictly to the conditions for which the essay was to be written, and to give as much practical information upon the subject as my humble ability permitted. I have carefully avoided all theories and probabilities, and given results obtained from practice and experience. Much has been written upon this subject before, but it has failed to give that practical information intended, and they have been mostly theoretical publications. The chronometer maker looks to the seconds-hand, which tells him its true tale; and how often has this hand denoted the tale of unsuccessful plans, false theories, and great disappointment? If this essay will prevent more of this loss of time and disappointment my task will have been well fulfilled. In every good chronometer the practical and honest artisan imparts to it a value that cannot be seen, or displayed upon its highly-polished surface or outside case, which are looked upon by *some persons* as a thing of more importance than the intrinsic merit, or unappreciated talent, bestowed upon the chronometrical adjustments. The time and talent required in bringing instruments up to the high degree of perfection required for the especial performance of high-class chronometers, such as I have alluded to in Chap. III., is known only to those who devote their practical skill in endeavouring to attain this degree of perfection. Excessive competition and a false endeavour to please the eye have caused many men to lose sight of the requisite adjustments the ordinary compensation balanced chronometer is capable of, and is actually necessary that it should receive. In an honest chronometer the springe devotes his time and talent to isochronal and con

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* C. Frodsham on "The Isochronism of the Balance Spring."

[21829.]—Referring to Mr. Stretton's letter, page 15, I would again explain that the braked train as running on the Liskeard and Caradon Railway does not represent the *entire design*; and consequently it is not urged or assumed that as there exhibited it complies with the Board of Trade conditions. It has been explained that, owing to mineral trucks unfitted with connections being run between the engine (at present also unfitted) and the coaches, the brake was "returned" as not complying. I have been endeavouring to show even the non-technical readers that the coaches were fitted with the apparatus merely to prove (as it has amply succeeded in doing) that the speed of a train can be as readily and effectually checked by a simple mechanical arrangement actuated, not by an exterior foreign energy, but by the momentum of the train itself. It is true up till now no brakes, whether mechanical or atmospheric, have proved entirely satisfactory. This is admitted on all sides; the extreme diversity in the systems used conclusively showing that no decided approval exists sufficiently to warrant any one of them becoming the universal brake. It is considered by many eminent engineers and inventors, that the solution of the brake question will be found before long, in some simple mechanical arrangement worked by the ordinary carriage axle. I trust, with Mr. Stretton, that before long we may have the opportunity of seeing this brake working on a large number of vehicles at once. No doubt at present very considerable prejudice exists against mechanical brakes, and greatly deters their receiving the attention they deserve. It may almost be regarded as an axiom, that the simplest means of securing a result is the best; therefore any apparatus capable of obtaining all the advantages and more, must eventually supplant those complicated arrangements wholly dependent upon an external source for supplying the power to absorb an energy, which might itself be used to obtain the result required.

Imprimatur.

MICRO. SLIDES.

[21830.]—The long evenings are approaching, and I am sure that a great many of your readers would be delighted, as well as be profitably employed, if some of your subscribers who are experts at the preparation of micro. slides would give clear and detailed formula for their preparation, especially for the preparation of those from *chemicals*, many of which are so splendid with the polariscope.

I shall be pleased to add my contribution to what I now suggest, having for some years successfully made many such slides; but have often signally failed by reason of the vehicles used for mounting them, dissolving the crystals. Information on all these points would continue your valuable weekly as an "educator," and be hailed with great satisfaction by many of your subscribers and readers.

If a "Micro. Slide Exchange" could be established, it would be another great boon; as when an operator has his arrangements made he can easily produce a dozen; what not required, to go in exchange for what perhaps he has not a facility for producing.

R. W. A.

LEGAL REPLIES.

[21831.]—Horse and Hedge—Damage (51558.) A. had a right to let his horse graze upon his own field, and if he strayed into the querist's field of corn adjoining, then the only question is whose duty was it to repair the hedge between the two fields? If A. is right that his horse strayed through a hole in the hedge belonging to the querist, then he is not liable. The only way to decide the question will be by an action in the county court for the value of the corn damaged. The expenses of the valuer can only be obtained if they are allowed by the judge in his attendance as a witness at the hearing of the case.

Building Society—Sale of Shares (51561).—This looks like an actual sale of the shares, as the price was agreed upon, a deposit paid, and the books handed over to the buyer. If this was all that had to be done by the seller, the sale was complete, and he had better sue the purchaser for the agreed price, giving him credit for the deposit as a sum paid on account. Presuming, however, that the transaction cannot be considered as a sale, then the querist's only course is to sue the buyer for specific performance of the contract on the basis of the letter, and the payment of deposit on a first performance. Probably, since the Judicature Act, this form of relief and remedy can now be obtined in a county court as well as in the High Court of Justice.

New Bankruptcy Act (51609).—There is no clause protecting property from seizure by landlord in this Statute. Probably the querist means Section 122, which protects a debtor's property to the extent of £20 from seizure under a County-court execution after an administration order has been made against him on the ground of his insolvency. But this has nothing to do with rent. Section 122 is of great importance to County-court debtors and creditors equally, and it should be read carefully by all concerned. I have just published the whole of the new Bankruptcy Act, with an introduction and notes, which I can send by post for twenty stamps.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

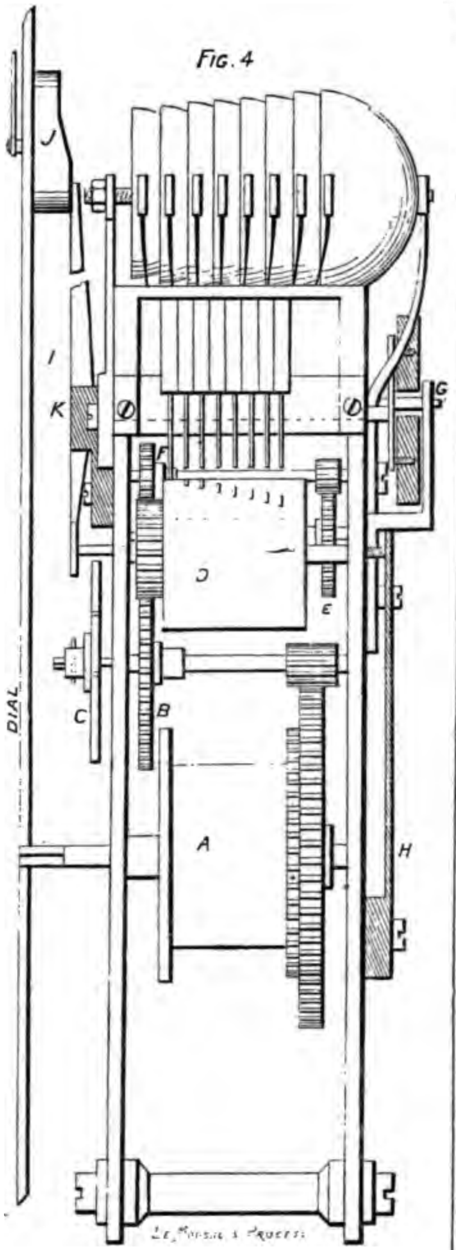
CHIME CLOCK MAKING.

[21832.]—Various causes have hitherto prevented the completion of the articles on Chime Clock making, and I must apologise for the delay.

The hour striking train was last described. Fig. 4 shows the chiming or quarter train. The barrel A carries the great wheel which drives the second wheel and pinion B; the front pivot of this pinion projects through the frame, and has the locking plate C squared on to it. The wheel B drives the nut of 40 which is attached to the chime barrel D, and also the pallet wheel and pinion E. The warning wheel and pinion F are driven by the wheel E, and the fly pinion by the warning wheel, the back pivot of the fly pinion being carried by a cock G as in the striking train. The spring H on the back frame and the lever I on the front frame are for pumping the chime barrel to play either on eight bells or the Westminster chimes. This arrangement will be fully described when the chime barrel is pricked and pinned, directions for which I will give in my next.

W. Baldwin.
110, Richmond-road, Dalston.

FIG. 4



IOTA^1 LIBRÆ. (♅ VI. 44. = SH. 376.

[21833.]—The wide pair ι^1 Libræ was discovered by Sir W. Herschel on the night of May 24th, 1781. The measures since have been both few in number and very discordant. The original record in the *Phil. Trans.*, Vol. LXXII. (1782), p. 154, is:—"May 24, 1781. Double. Very unequal. L. w.; S. dusky r. Distance 1′ 5″ 10‴, not accurate. Position 22° 31′ *s.* following." Sir John Herschel, in his Synoptical Catalogue of his father's observations (Mem. R.A.S., Vol. XXXV., p. 91), writes:—"A B 1782·359 112·52° 1 obs. A B 1781·392 59·07″ 1 : : obs. In printed Catalogue:—"Distance = 1′ 5″ 10‴, corrected in margin by C. H. [Caroline Herschel] to 59″ 4‴. Correction verified." I find the following in the MSS.:—"May 24, 81, 59″ 4‴ [written over some figures, evidently 1′ 5″ 10‴, which have been erased with the aid of a penknife]; superficial measure very unequal the small one very obscure. May 12, 82. L. w., S d r. Posit. . . . 22° 30′ *s.* foll." It is a little strange that as the paper was read before the Royal Society on January 10th, 1782, the date of the measure of the angle should be given as May 12th, 1782; but this measure was probably added later on. The star was next examined by Sir J. Herschel and South (*Phil. Trans.*, CXIV. (1824), Part III., p. 410).

It is placed in the Appendix as being one of those "less perfectly measured, or of which, from their uncommon difficulty, the observations are too precarious to be received as satisfactory." The first measure is stated to have been made on May 28th, 1822, with the *five* feet equatorial, position 23° 45′ *s.f.*, distance 50·629″, "little better than guessing"; and the star was again observed with the same instrument on April 11th, 1823, position 18° 30′ *s.f.*, distance "about 60 seconds," and mention is made of a distant third star, precisely in a line with A B; the mean of the two evenings' measures being 21° 39′ *s.f.* 50·629, 1822·84. H and Sc. quote Sir W. Herschel's result as 22° 31′ *s.f.* 59·05″, observing that "the diminution of distance (could it be fully depended on) would be very remarkable." With the exception of a measure (?) of Smyth's (110·5° : 51·3 : 1837·43), it seems to have been neglected until β. discovered the duplicity of the companion with the 18½in. at Chicago in 1878. The mean of his observations gives A.B. 110·6° 57·40″ 1878·98 (five nights); B C 24·8° 1·32″ 1879·00 (five nights), and he suggests (Mem. R.A.S., Vol. XLIV., p. 185) that Sh.'s measure should be 58·63″ instead of 50·63″. I find, however, that a very curious error has been committed by H$_2$ and So. They give, as usual, the value of the measured distance in parts of the micrometer employed, and it will be seen that, instead of using the values of the 5ft. equatorial micrometer, they have taken those of the 7ft., with which the observations were, I think, undoubtedly made, the companion being too faint for the smaller instrument. The distance is, therefore 66·502″, instead of that printed in the *Phil. Trans.* It is, of couse, almost needless to say that the measures of distance made with the 7ft. refractor are, on Sir John's own showing, quite unreliable. I am afraid that it will be necessary to take β.'s measures of 1878 as our starting point in any future investigations as to the motion of this triple. The *p.m.* of A seems to be small, Mü. gives only 0·041″ in 181·4°. I am not aware of any measures of ι^1 Libræ other than those quoted above; but if any reader of the English Mechanic has come across some, I hope he will communicate them.

Sept. 14. **H. S.**

DAYLIGHT OBSERVATION.

[21834.]—It may interest some of the possessors of limited optical means to know that stars as small as the third mag. may be very well seen in the daytime with an aperture of 2¼in. I once had a very fine view of Castor at due noon, with a telescope of that size, the two components of the star, respectively of the 3 and 3·5 mags., being perfectly easy to see, and apparently smaller and wider apart than at night, owing, I suppose, to the absence of surrounding glare in a light sky. My telescope having only a simple altazimuth mounting, I obtained this view by pointing the telescope at 11.25 on the preceding night to a part of the sky which included γ Lyræ in the field (this star having nearly the same declination as Castor), and leaving the telescope undisturbed until noon of the following day, at which time Castor entered the field, there being a difference of about 12h. 33m. of R.A. between the two stars. The power I used was 64. By the same plan—a most tiresome one in this climate, however—I obtained mid-day views of Polaris, Aldebaran, Sirius, Procyon, Pollux, Vega (very conspicuous), Deneb, Arcturus, and Betelgeuse. I saw the last-named star in a very transparent opening between clouds in rainy weather, and I have noted it down as a specially beautiful daylight object. Polaris, on one occasion, was so very distinct that I even tried to see the companion, but of course without success.

The same telescope also gave me a most exquisite view of the crescent of Venus at 4.30 in the afternoon of July 14, 1876, 6¼ hours after the planet's inferior conjunction. I have no doubt the crescent would have been visible to me at the moment of conjunction, but having to "fish" for it within six degrees of the sun, I failed to find it that time.

A small star in the field in daytime cannot be seen at once, as it would be at night, but has to be carefully looked for to detect it.

R. Y.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51223.]—**G.W.R. Narrow Gauge.**—The stations of a few of the engines I inserted in Nos. 961 and 962, are as follows:—158, 159, 162, 165, 165, 166, 1117—1120, 1124—1126, 1128—1131, 2212—2215, 513—515, and 606, Paddington. 157, 160, 161, 164, 1116, 1121, 1127, 806, 807, 810, 1111, and 1429, Wolverhampton. 718, 721—723, 725, 726, 821, 598, 600, 601, 1087, 1092, 1094, 1099, and 1427 Birmingham. 1122, 1123, 811, 1106, 1108, 1109, 1114, 658, 664, 665, and 667, Gloucester. 383, 384, 387, 478, 480, 577, 580—584, 586, 430, 493, 501, and 389, Oxford. 379—381, 614, 625, 631, 632, 688, 1422, 1434, 1435 and 2201, Bristol. 385, 474, 479, 2202, 2204, 2205, and 2207, Swindon. 809, 814, 816, 818, 819, 824, 660, 661, and 687, Neath. 215, 517, 564, and 1424, Stourbridge. 717, 719, 720, 724, 621, 395, 509, 607, and 612, Cardiff. 545, 550, 555, 1431, 391, 402, 419, 425, 427, 512, and 1097, Worcester. 361, 398, 431, 595, 1439, and 1443, Hereford. 363—369, 1083, and 1110 Shrewsbury. 79—90, and 350—359, Pontypool-road. 378, 473, and 578, Birkenhead. 1186—1215 are mostly at Bristol, Paddington, Oxford, and Swindon, respectively. 1501—1560 are mostly at Wolverhampton. 1561—1656 are distributed between Bristol, Cardiff, Swindon, Aberdare, and a few other towns; but are mostly at Swindon and Aberdare. 1801—1812 are mostly at Wolverhampton. To give stations of the others would take too much space. I was mistaken before in saying that 69—76 are goods engines: they are 6ft. 6in. singles.—J. E. SPENCER.

[51229.]—**Dark Slide.**—To MR. LANCASTER.—Instructions for dark slides in another week or so: have been too much occupied to write before. Your filtered rainwater will answer every purpose, and for developing, if distilled water is not easily obtained, then put out basins, dishes, &c., and catch all the rain you can as it falls before going down a roof. If you are short of water, then you can temporarily use the hard water after boiling it for an hour.—W. J. LANCASTER.

[51231.]—**Gold Printing on Silk.**—I notice in your issue of the 7th inst. the reply of "C. T." to above query, which may be right enough for an amateur who desires to produce, perhaps, at most half a dozen copies; but as a means of printing neckties, &c., or even weaving the designs or names on them, your querist will find them in the "afternoon" in point of cost and speed. To do this, to be commercially successful, your querist will need a press and set of blocks or dies, to enable him to stamp about one gross per hour, the price he would get for his work ranging from 2s. 6d. upwards, according to size of design. Further information can be had if your querist will write as below.—FAULKNER, Denton.

[51253.]—**New Zealand.**—I should like to have "Imprimatur's" advice. I am forty-eight years of age; not strong, and unmarried. I should like to go to New Zealand, but could not work hard. I have been used all my life to small jobbing repairs of small houses. I have a capital of, say, £1,000. What could I do with this to bring in a living without much hard work? I could not tackle farming—I do not understand it, being a town-bred man.—OLD SUBSCRIBER.

[51253.]—**New Zealand.**—To "IMPRIMATUR."—I should be glad if you would give me some further information about this colony. What part do you think it would be best for an engine-fitter to go to—Otago or Auckland? I also want to know if a lady would be able to establish a private school for young children with success. Kindly say if New Zealand is considered more healthy than England—how it will suit neuralgic subjects. Can money be made building houses? I can do joinery work as well as fitting? What amount of interest can be got in safe investments for sums of about £200? Are clothes expensive in N. Z., and what clothes would you advise us to take? Are there any ways of occupying one's time on board ship by which I could prevent my hands getting soft, and as a means of making some little towards expenses—if I could make anything that could be sold on arrival? Any information that you can give will be a great favour to—ENGINEER.

[51274.]—**Overstrained Piano.**—In my reply last week it appeared that I gave £30 for a worthless piano, whereas the price should have been 30s. It is very likely the printer thought I had made a mistake, which was true enough, though not in the sense he intended. My object in stating the price was to prove how little value a cottage piano may represent, when it will not bear the tension of the strings, and to warn amateurs against too hastily concluding that such a piano must necessarily be worth the trouble and expense of repairs.—W. H. DAVIES.

[51274.]—**Overstrained Piano.**—I am glad to see a letter from Mr. Davies, who, I trust, will not feel offended if I point out that the cast-iron stays that he advises, though extremely useful in the higher treble, will not be of much service in the bass. If the backposts are really 3in. square, they are very badly designed, and the stays will not prevent some flexure or bending in the bass. What would in that case be really required is some front iron bracing in the bass, and one or two stays in the higher treble, as there is no room there for screws below the wrestplank bridge. I would strongly advise "P. Pianist" to try the screws first, and secure the bent side with some; this would be less trouble than the stays or iron bracing. If "P. Pianist" likes to advertise his address, I will lend him the number of "E. M." specially bearing on the defect of his piano, if he cannot obtain it from the office; it is at page 613, Vol. XIV.; and later on—if he find my screwing plan not sufficient—I would draw for him a plan and section of bracing. If the soundboard bars at the back are not unglued, the tone would not be injured, and I should think the soundboard would resume its proper shape and position from the downbearing of the wires.—J. C. L.

[51304.]—**Legal.**—This question is so complicated that it should be submitted to a solicitor with all the documents. If B. has not signed an agreement, he has *not*, and therefore cannot be bound by it, whatever he may be by any other document.—NUN. DOR.

[51313.]—**Power of a Wind Fan.**—This querist should say more distinctly what it is he wishes to learn.—T. P.

[51315.]—**Lighting Gas by Electricity.**—To MR. W. J. LANCASTER.—You should buy the steatite burners with the terminals already fitted; then connect them to wires from a Ruhmkorff coil, turn on the gas and then put coil in action, and the gas will instantly light. The whole thing is easily done: but it will be far better for you to buy the burners ready made than to attempt to make them.—W. J. LANCASTER.

[51315.]—**Lighting Gas by Electricity.**—This is done by passing a current through a platinum spiral, or by means of a spark between two platinum points. Probably the arrangement the querist saw was something like this: A magnet so placed as to pull the platinum coils over the burner when the current is passed, leaving them to fall back or be pulled back by a spring, when the current ceases, and the gas is alight.—S. M.

[51317.]—**Hand Punching Machine for Nuts.**—You want a hydraulic punching bear. There is one illustrated on p. 57, No. 931. Get some of the lists from the makers of these tools and you will find several designs.—ESSAR.

[51321.]—**Filter Beds.**—No material is fitted to be a permanent filtering medium; but it depends on more than "Antares" states what would be best to be done in his case. Is the 6ft. space already a brick-in-cement cistern, and has he an available supply of clean sand? If not, and the river will supply the tank by gravity, it would be cheapest to build a "canal" between river and tank and in grooves in the sides and bottom of "canal" slide stout frames, holding diaphragms of felt, which could be easily removed and cleaned as required. If gravel and sand are used, then it would be better to let the water flow on to the top of the gravel, and filtering through the sand, find its way into a central cistern of brick-in-cement by apertures at the bottom. The pump pipe enters this cistern, which is, in fact, a hollow cylinder of brick or iron stood in the centre of the filtering bed of sand and gravel. Should be allowed to stand dry one day a week.—NUN. DOR.

[51329.]—**Electro-Magnetic Machine.**—You will be unable to do anything with a magnet so small. It is altogether out of the question to obtain even a glimmer from a machine of such a size as your magnet would make. Carefully read all that you can about dynamos, and then make up your mind what to do. It is a pity to waste both time and money (for that is what you would do) if you attempted to build a dynamo with so small a magnet.—W. J. LANCASTER.

[51341.]—**Induction Coil.**—Your bobbin will answer for building a coil on, only it would be better to cut away the wooden tube altogether, and build up as follows:—*Core*: A bundle of wires making in all a core 9in. long and ¾in. in diameter, fasten the wooden discs, or what would be much better, two ebonite discs, at each end of the core: cover the core with one or two layers of paraffin paper. *Primary*: On to the core wind carefully two layers of 16 silk-covered wire, as close together as you can wind it; then bake the primary with solid paraffin in an oven for an hour, and insulate it from secondary with an ebonite tube $\frac{1}{16}$in. thick, or paraffin paper folded round and round until it is at least ⅛in. thick in the centre and $\frac{3}{16}$in. thick at each end. *Secondary*: Wind all the 36 on in successive layers, insulating between each layer with paraffin paper until all is wound; then you should again bake in paraffin. When finished you ought to get a 1¼in. spark with ease.—W. J. LANCASTER.

[51342.]—**Clarionet or Oboe.**—Please correct an error which appeared the week before last in my answer to "Woster." The sentence "There is 'one' mysterious wrinkle in the 'set' of a mouthpiece," should have read, "There is 'no' mysterious wrinkle," &c.—CLARION.

[51343.]—**Pens.**—"C. R. T." does not say of what his pen is made, nor describe the nature of the ink. Some steel pens are washed with a metal which protects them for a considerable time, even in the common iron-and-gall inks; but ordinary pens last a very long time with aniline inks. As "C. R. T." says his pen is "absolutely incorrodible," I suppose it must be gold, and therefore not much affected by anything likely to be used for ink.—NUN. DOR.

[51346.]—**Clarionet.**—In reply to "Vulcanite's" observations on page 42, I may state that in the first place $\frac{7}{16}$ was a mistake, as it should have read $\frac{5}{16}$, and that it would be as well if he would state "from what part of the reed he would measure the length of any clarionet." Also, whether he means to insinuate that a violin, an organ pipe, or the soundboard of any musical instrument, would be improved, or vice versa, if constructed of either cocoa (or cocus), of boxwood, or even of ebony. Finally, when he proves the defects of suitably selected spruce timber for resonant qualities, I will talk to him.—A., Liverpool.

[51346.]—**Clarionet.**—In reply to "Vulcanite," I do not mind what kind of clarionet I attempt to construct: just which you think best for an amateur. I think you will see that there is a great interest taken in these matters, and hope you will be so kind as to send article on "Tubes with Sounding Holes," which I suppose will include the question of nodes. With regard to kind of brass, I know so little about this instrument as to suppose the reed was of brass, which I now see is wrong. I entirely agree with the latter part of your reply, and hope you will enable myself and others to do so; and I think that practice should always be guided by theory as far as possible. In reply to "Clarion" about small F clarionet, Westrop, in his "Clarionet Tutor," says: "The small F clarionet is used in military bands, the sounds of which are a fourth above those written": which is all that I know about it. Thanks to "A., Liverpool," and others who have replied.—J. J. D.

[51346.]—**Clarionet.**—"Clarion," page 20, gives our readers no encouragement to make their own clarionets; he is afraid that those who attempt it "will not be very successful." Now, as I presume that most of our readers are either professional or amateur mechanics, I really see no reason why they should not make their own clarionets as well (for instance) as their own telescopes. My reason for saying this is, that I have tried, and succeeded, and when I began I was not a mechanic in any sense of the word, neither was I acquainted with theory. However, I was a player, and therefore knew a good instrument when I took hold of one, and having found one to my fancy, worked from it, and the result is a good instrument; therefore I say there is every hope of success for those who may wish to make their own clarionets. "A., Liverpool" (page 42), does not find that removing the bell sharpens any note whatever. Now, as I say it does sharpen the lower notes and their harmonics, I shall be glad if some third person will give his experience, and so prove to our readers which is right.—OLD BLOW HARD.

[51347.]—**Poultry.**—There are many books on poultry, from Wright's, published by Cassells, to one about sixpence, in which the author gives his method of making poultry pay. There are some books of the kind published at the *Bazaar* office, and a good deal of information in back volumes of this paper.—NUN. DOR.

[51353.]—**Brass.**—"Scotch Reader" might try copper 88, tin 10, zinc 2. A little lead might improve it. Much depends on the purity of the metal used, and on the skill of the melter. If small quantity only is wanted, better buy it of a good firm.—NUN. DOR.

[51356.]—**Vacuum Tube.**—Make a frame covered with black velvet, with pieces of elastic sewn on so that the tube can be placed under the elastic and be kept firm. The elastic should be as thin as you can get it, and black, so that it will not show. This is the simplest way of holding them, and one of the most effective I know of.—W. J. LANCASTER.

[51358.]—**Geological Exhibits.**—There are lots of lantern slides of geological subjects published. Write to some of the makers of lantern slides for their catalogues, and then select to suit your requirements.—W. J. LANCASTER.

[51397.]—**Motor.**—To MR. LANCASTER.—Don't bother with the Griscom. You will not have fall enough to work a water motor. The thing you can have is a one-man gas engine.—W. J. LANCASTER.

[51432.]—**Clarionet or Oboe.**—Having played these instruments alternately for the last dozen years, I venture to reply to this query. The oboe is distressing to ordinary players, as it is quite impossible to expire entirely through it, so one has to partly inhale and exhale, independent of the instrument. Very few, even professional players, can do this with comfort. The clarionet, on the other hand, will take as much wind as one likes to give it, so that, with a suitable mouthpiece, no distress is felt, and the performer requires to inhale only. I believe the oboe is not good for the health, and doubt if it strengthens the chest for the above reasons. As to the clarionet, I never had a cold in my chest above a day since I commenced to play, the general opinion being that the oboe is bad unless played from the chest and throat, like Mons. Lavigne, Reynolds, and one or two others. It is done the same as an ordinary chemical blowpipe, the difficulty being that it takes far more air than an ordinary blowpipe.—VULCANITE.

[51447.]—**Switch for Lamp.**—From what I understand of your query, I infer that you either use the current for lamp, or you short-circuit, letting the current really waste. This is wrong altogether. Each time you cut the lamp out of circuit you should so arrange that the current is broken: then there will be no waste, and you will have best effect.—W. J. LANCASTER.

[51455.]—**L. and N.W. Locos.**—2453 is a coal engine (Webb) with cylinders 17 by 24, six-coupled wheels 4ft. 3in. in diam., and weighs between 29 and 33 tons. 2455—2457 are Mr. Webb's 4-wheel shunting tanks, with dome and chimney combined, footplate at either end, firebox fitted with water-tube firegrate, Allan's straight link. The following are chief dimensions:—

Diameter of cylinder	9in.	
Stroke of piston............	12in.	
Diameter of wheels	2ft. 6in.	
Total wheel base	5ft. 6in.	
No. of tubes (120) out. dia..	1⅝in.	
Length of tubes between tube plates	3ft. 6in.	
Total heating surface	257·86 sq. ft.	
Firegrate area	5·47 sq. ft.	
Capacity of tanks (below footplates)	260 gals.	
Weight of engine roadworthy:—		
	tons.	cwt.
Leading wheels	7	11
Driving wheels	7	12
	15	3

Several engines of this class do shunting in Crewe Works Yard.—TITTESWORTH.

[51475.]—**Coil.**—Three layers for primary are ample; in fact, two layers, well wound, are almost sufficient. But in the coil you are making, three layers will do well, and you would lose by putting four layers. You must have as nearly perfect insulation as you can possibly get, to make your coil give its full work. This, of course, you know, and the importance of winding the secondary as smoothly as a reel of cotton.—W. J. LANCASTER.

[51484.]—**Reed Organ.**—"Organon" recommends me to build a pipe organ if I wish to go beyond 2 man. and ped. The reed instrument would not be tolerated were the former practicable, which it is not, on account of space, power, and cost. I do not quite see why pipes cannot be tuned to reeds. To Mr. FRYER.—The 20 rows would be of 5 octaves each, and do not include ped. reeds (say 4 sets of 30 notes). Couplers reqd.: man. to man. (3), ped. to man. (3). Number of sets on each man. undecided; should like advice and brief specification: 8ft. tone must predominate, not more than 2 (or 3) 16ft. reeds on manuals, and 3 (or 2) 16ft., with 1 (or 2) 32ft. on ped. What size bellows and reservoir (on equal-pressure principle) would be required for above, and what pressure upon reservoir?—G. MINOR.

[51497.]—**Small Brace.**—I have seen several answers to the above query, besides many sketches of drills. But they are all useless for the purpose required (that is, if 25 years' experience is any authority). What E. Owen requires is a drill stock, breastplate and bow, what is termed a fiddle drill, and the drill must be a diamond one, the same as is used by all china restorers. The best metal to set the diamond in is thick copper wire. Setting them in tubes is an old and clumsy mode of setting them not used by anyone in the trade. There have been many answers given to similar queries by persons who could have had no knowledge of the subject.—B. A. C.

[51500.]—**Mathematics.**—Hoping "Poor Labourer" will not find himself puzzled by the number of replies to his question, I venture to add one more. In integrating, as J. F. Wilkinson has done, if symbols are put instead of figures, the rule comes out thus: Let a and b = length and breadth of the base, c and f = length and breadth of the top, also h = height, then the contents = $\frac{h}{6}(2 . a . b + 2 c . f + a . f + b . c)$, that is, twice the area of the base, added to twice area of the top, added to length of base multiplied by breadth of top, added to breadth of base multiplied by length of top; the sum of all this multiplied by one-sixth the height. If c or f be made = 0, then the rule becomes that of a heap whose top is a line, and if c and f both = 0 the rule is of a pyramid. Applying the rule to the cases required, 1st, let $a = 11$, $b = 10$, $c = 5$, $f = 5$, $h = 5$

$$\begin{array}{rrl} \text{then } 2 . a . b = & 2 \times 11 \times 10 = & 220 \\ 2 . c . f = & 2 \times 5 \times 5 = & 50 \\ a . f = & 11 \times 5 = & 55 \\ b . c = & 10 \times 5 = & 50 \\ \hline & & 375 \times \frac{5}{6} = 312{\cdot}5 \end{array}$$

2nd. Let $a = 20$, $b = 10$, $c = 15$, $f = 5$, $h = 5$.

$$\begin{array}{rrl} 2 . a . b = & 2 \times 20 \times 10 = & 400 \\ 2 . c . f = & 2 \times 15 \times 5 = & 150 \\ a . f = & 20 \times 5 = & 100 \\ b . c = & 10 \times 15 = & 150 \\ \hline & & 800 \times \frac{5}{6} = 666{\cdot}\frac{2}{3} \end{array}$$

The extraction of the square root is avoided by this rule.—FRANCIS MARTIN.

[51532.]—**Stern-Wheel Steamers.**—If "Anton" will get *Engineering* for Friday, Sept. 7th, and refer to page XL. of the advertisement sheets at the end of same, he will find a good illustration of a stern-wheel steamer, which may be of service to him.—KERAULOPHON.

[51540.]—**To Mr. Lancaster.—Solar Spectrum Photographing.**—You may alter the size of image considerably by using a shallow concave just in front of the Méritoire lens. Thus, a 48in. concave will make the lens 1in. longer in focus, and a 24in. will make it more than 2in. longer in focus, in each case giving a proportionately larger image on ground glass. By altering the position of the concave, you will also vary the size of the image. It is an easy matter to enlarge the small negative you have already obtained; but I think it is worth the trouble of a few experiments to get a good photo.—W. J. LANCASTER.

[51544.]—**Induction Coil.**—Three layers will be quite sufficient for your coil. If you will read answer No. 51341, and then if you want further information, write another query, I shall be pleased to help you.—W. J. LANCASTER.

[51545.]—**Rust on Hairsprings.**—I must apologise to "A Fellow Workman" for the delay in replying to his query; it has been unavoidable. Respecting the appearance of rust upon hairsprings after they have been immersed in acid to weaken them, I imagine that they were not sufficiently cleansed in the afterbath, if you used one. If you omitted to remove all traces of acid by immersion in spirits of wine, or other liquid, then the rust may easily be accounted for. If you have taken every known precaution against the formation of rust, then I should say the appearance of rust afterwards is accidental, caused by exposure to damp in one form or another. The colour produced by oxidisation upon the metal is a preservative from rust, and as the act of immersion in acid tends to destroy and remove that colour, some preventive must be adopted, and I know of no better than to dab the spring with paper, or something ever so slightly moistened with clean oil. I am sorry I cannot give you an absolute rule as regards the sizing of barrels, springs, and balances when either are absent from watches. No doubt actual manufacturers have certain well-defined lines upon which to work in laying out or planning watches; but I am not a manufacturer, and in replacing a lost balance, barrel, or spring, I should be guided more by knowledge and common sense than by rule or theory. After many years of practice in the work, one gets almost intuitively to know what kind, length, or strength of spring: what size barrel, balance, or missing wheel such and such watches require, without depending in any way upon set rules. When a wheel is lost, of course, the train numbers must be ascertained, as it would never do to take any wheel that happened to be the right size unless the number of teeth and pinions corresponded with the lost one. For instance: Supposing a centre wheel with a pinion of 10 and 57 teeth was set in a watch from which a wheel having a pinion of 12 and 54 teeth had been lost, no correct timekeeping, even if the watch went well, could possibly be got out of it.—ALFOJOE.

[51556.]—**Chemical.**—The substance mentioned in the first part of this query is probably silica; if so, it would be insoluble, when heated before the blowpipe in microcosmic salt; it would dissolve with effervescence, when heated with excess of sodium carbonate, forming a clear glass, which is soluble in water, and from which solution dilute HCl would precipitate the silica in a gelatinous form. The oxides of the rarer metals combine with alkalies when heated with them, forming an *opaque* mass, from a solution of which acids throw down the oxides, but the precipitates thus formed are soluble in microcosmic salt, when treated as above; they may be dissolved in HCl, and treated with zinc as below. The blue powder may be fused with $KHSO_4$, dissolved in water acidulated with HCl, and a strip of metallic zinc placed in it. If molybdic acid is present, the solution turns colour, first blue, then green, and finally dark brown; if tungstic acid, blue, then copper-red; if vanadic acid, blue, green, lastly violet; if titanic acid, violet. "A. E. S." will find the blowpipe the easiest means of detecting these metals.—W. E. HADEN.

[51557.]—**Nickel Plating.**—Thanks to "E. A. H." for his answer to my query. I see Gore mentions similar solutions. I have not tried them yet, but intend doing so, as "E. A. H." recommends them. May I ask what proportions he recommends to make one gallon of solution; also, the ammonia nickel being liquid, how shall I determine the proper volume of bisulphite being a solid. Now, as to batteries, I have no bichromate cells, but if the result would prove more satisfactory, I would construct some. What size should they be each, the surface of zinc exposed and relative proportion of carbon surface to get the most out of them? Also how often do they require recharging? Will commercial nitric acid do for dissolving nickel, or should I use pure. I find the former dissolves it more rapidly (what is the dark red gas evolved?) Is it necessary to crystallise before using? I find the crystals liquefy on being brought into a warm place. Is this right? Since writing my original query, I have deposited from a solution of nickel and ammonia. The deposit is firm and regular, but of rather a dark colour. How could I make it whiter from this solution, as I have a quantity of sulphate which I wish to utilise. Can "E. A. H." or any other reader tell me how to get the high polish on nickel-plated articles, which we find on bought goods. Details of the process will oblige. What appearance should goods present on coming out of the bath? The name of some recently published book, treating on the whole subject (if such exist) will oblige—ONE STILL IN A DIFFICULTY.

[51560.]—**Atomic Theory.**—The mechanical theory considers atoms in relation to physical forces only, and has no regard to the composition of the atom. Thus, according to this theory, an atom is the ultimate particle or unit of matter; yet this atom, as it is termed, may contain two or more chemical atoms. Take for example the common mineral—sulphide of copper; an atom of it will contain both copper and sulphur in the proportion of 63 parts by weight of copper to 32 of sulphur. Here we see the physical atom contains two chemical atoms of unequal weights. Such examples are almost unlimited. The atomic theories are simply theories, as it is quite beyond our power to ascertain the absolute condition of the ultimate particles of matter. No physical power we possess can enlighten us as to how the copper and the sulphur are combined together in the sulphide. No particles of the separate elements can be detected by the highest power of the microscope, while the compound of the two elements is entirely different in physical properties from either of its constituents. Therefore, we can only suppose they are united together in what we term atoms, the definition of an atom being "the smallest particle of a body, which undergoes no farther division in chemical metamorphoses." From the fact that in sulphide of copper, the copper and sulphur being always found in the proportions above named, we can reasonably infer that the relative weights of the atoms are 63 and 32. A chemical atom differs also from a physical one, in being the centre of a great attractive force, which is termed "chemical affinity." This affinity is not of the same intensity between all atoms. In conclusion, the physical atom corresponds to the chemical "molecule," which is a combination of two or more atoms, far more than to the chemical atom, especially as the latter is supposed to be incapable of existing in the free state, but must unite with another atom to form a molecule, as appears evident from chemical reactions. One can hardly expect the two theories to coincide exactly, as they are put forward to explain very different phenomena.—W. E. HADEN.

[51563.]—**Shaft.**—Your shaft will break with a load of about 250cwt. If the arms are arranged symmetrically round it, they, and the weights they carry, may be taken as dead load.—GLATTON.

[51565.]—**Photographic Printing.**—Please give the recipe you mention.—P. C. W.

[51568.]—**The Audiphone.**—If your correspondent is so very deaf that he cannot carry on a conversation with friends when speaking close to him, and his deafness does not arise from the auditory nerve being affected, there are various little plans by which he may be assisted if he has sound upper teeth, and I will mention two or three if you think them of sufficient value to give them pubfamilies from compulsory vaccination. Not only so; they are forced upon them. Before we had vaccination as by law established none were found to complain of the results; but since it was compulsory the mixed up manner in which the operation is often performed brings many complainants. Had the compulsion been confined to a family or neighbourhood suffering from small-pox all purposes would have been met, and the arbitrary character of the enactment avoided. "W. M.'s" doctor says of his child's case that "it is nothing, and will go off." We may suppose, like a gun, loaded or unloaded. Skin complaints inoculated with vaccine are difficult of cure.—VACCINATOR.

[51633.]—**Boot-Sewing Machine.**—Perhaps the presser foot spring is not strong enough. Put more pressure on foot and raise feed-teeth up very slightly, tighten the shuttle tension and then the top until it pulls locking of stitch well between the leathers. You can do this until the threads will not stand it and will break; if they do, you must slacken again. Have you got an awl-pointed needle? If not, get one, and you will most likely succeed after following the above.—J. I. S.

[51634.]—**Cleaning Stove Pipe.**—A piece of zinc thrown on the fire is said to effectually clean a stove pipe by chemical decomposition of the soot. —H.

[51634.]—**Cleaning Stove Pipe.**—The "substance" you wish to know the name of is ordinary zinc. I have not tried it myself, but I hear that on putting some of the metal on the fire the soot up the pipe disappears like magic.—R. A. R. BENNETT.

[51634.]—**Cleaning Stove Pipes.**—Your stove must be badly arranged to make so much soot (wants more air amongst the fuel). Think the substance inquired for is the old housewife's remedy—viz., a small quantity of gunpowder.—A., Liverpool.

[51635.]—**Photography.**—The blistering of the prints is more likely owing to the lighter sp. gr. of the water than to its impregnation with air. Try the effect of some common washing soda in your fixing bath, say 1 oz. to the pint of solution. This makes the paper more porous, and much less liable to blister than otherwise. If that does not answer, you might increase the density of the wash-water by throwing in a handful or two of common salt.—W. ROBINSON, JUN.

[51638.]—**Lathe.**—You had better get the parts turned and bored, if you have not a lathe. You cannot melt gunmetal in a wrought ladle, you can melt tin. I have a 4½in. back-geared lathe, the spindle of which runs in tin bearings.—W. W. EVERS.

[51641.]—**Seaweeds.**—Wash the seaweeds in a basin of salt water, and then float them singly in a dish of fresh water; push a piece of cartridge paper under the seaweed, and draw it out of the water, arranging it with a camel's hair brush, the handle of which should be finely pointed for separating the finer fronds. Cover the seaweed with a dry rag, and place it between several pieces of blotting-paper, and put it under a weight. The rags and blotting-paper should be changed every day, till the seaweed is quite dry. Thick seaweeds that will not readily adhere to the cartridge paper, should be floated in a dish of skimmed milk (instead of fresh water), and treated in the same way as the above.—E. F. B.

[51642.]—**To Mr. Lancaster.**—There is not any royal road to success in determining exposures; it is simply resolvable into two words—"Experience teaches," and to gain this experience you must be methodical. Make a note of every exposure—subject, time of the day, amount of light, and length of exposure. You will soon become proficient, and no longer will over-exposure trouble you. Besides this, as much care is necessary in developing. You can do wonders with the developer when you know how, and you must be your own tutor. The best workers have all had the same training.—W. J. LANCASTER.

[51644.] — **Model Boiler.** — Use methylated spirits of wine, either with or without wick.—P. C. W.

[51644.] — **Model Boiler.**—Try methylated spirit, or fit a small blast-pipe in chimney, the hole in pipe nozzle to be size of a pin.—W. W. EVERS.

[51644.]—**Model Boiler.**—You will, I opine, find that you can get sufficient draught for charcoal if there is no obstacle to prevent the lengthening of your chimney.—A., Liverpool.

[51655.] — **Signal Boxes.** — The diamond-shaped pieces of wood or tin painted white attached to signal-boxes indicate that the telegraphic instruments in the box are in proper working order. Should any failure or hitch occur to the instruments, these signs are reversed, the other side being coloured black, and this gives notice that repairs are required to those engaged in the telegraphic department.—W. H. Y. T.

[51655.] — **Signal Boxes.** — The presence of these white boards outside signal-boxes informs the telegraph and signal fitters that the apparatus under their charge is in good working order and repair, I believe. T, of course, means "telegraph," and S, as seen on the North Staffordshire Railway, stands for "signals," I suppose. On this line the diamond-shaped board is the telegraph and the oval the signal notice, and I think this is usually the case. I have always understood that the above is the use of these boards, and that an answer to this effect was given some years ago with especial reference to the G. E. R.—TITTESWORTH.

[51655.]—**Signal Boxes.**—The diamond and oval-shaped pieces of wood painted white, which are exhibited outside many signal-boxes, are for the purpose of informing the drivers and guards of passing trains that the telegraph communication and all signals in the box are in good working order. The other sides of these boards are painted red, and when this side is exhibited, it signifies that something is out of order in the box, affecting the ordinary system of signalling the trains. On some lines where these boards are not used (as on the L. and S.-W. R.), the telegraph being out of order is denoted by the exhibition of a small black board, and the signals by a red board; the absence of anything showing that all is in good order.—MACHINA.

[51655.]—**Signal Boxes.**—The North-Western signal boxes are provided by the telegraph and signal departments with oval and diamond-shaped boards respectively. The ovals are painted white one side and black the reverse. The diamonds are white and red. If the telegraph instruments and signals are in good order, the white sides are exhibited; but should any defect occur then the oval or diamond board (as the case may be) is reversed. The object in doing so is to get the attention of the men belonging to either department who may go by in a train, and who keep a sharp look out for such evidence of any defect. It thus frequently saves valuable time over simply reporting a fault to headquarters by wire or letter. Possibly on some lines both sides of the boards are painted alike; but on one side is the initial T for turned. The object is the same.—TRAFFIC.

[51656.] — **G.W. Engines.**—I am unable to answer either of "W. B. P.'s" questions under this heading, but would remark the presence and ask the signification of the two horizontal white diamonds on most of the goods waggons, brakes, and vans on the L. and N.W. Railway? A large white diamond is painted on the trailing wind screen of the metropolitan bogie tanks on this line, a flat diamond-shaped piece of metal being hung on the disc rings of the chimney.—TITTESWORTH.

[51658.]—**Light.**—You will find full instructions and diagrams in Profs. Mayer and Barnard's little book on "Light," published by Macmillan in their "Nature Series," 2s. 6d.—C. WALTER HEPWORTH.

[51659.]—**A Three-Cell Battery.**—"Physis" requires instructions how to make a three-cell battery as efficient as possible. The inquiry is very indefinite; perhaps the following information will be somewhere about what he wants. In order to obtain the greatest amount of power with the least weight and bulk, Grove's platinum battery is the best, but the use of nitric acid is so objectionable that in most cases it is better to employ a bichromate with strong acid solution. If, however, the greatest efficiency for the amount of acid and battery materials consumed is necessary, then a Bunsen battery with dilute nitric acid and weak sulphuric-acid solution is the most economical, but the weight of the battery has to be very much increased in order to equal the quantity of electricity given by a stronger acid. A sulphate or oxide of copper battery is both more expensive to work and less efficient as regards bulk and weight than the above; but in cases where there is occasion for constancy, it is perhaps as efficient as possible, and all other batteries have qualities which cause them to be used at times. "Physis" had better say what purpose the three-cell battery is wanted for if he requires instructions to make one.—J. SUTCLIFFE.

[51662.]—**Iron Developer for Dry Plates.**—Make saturated solutions of protosulphate of iron and oxalate of potash: then, supposing you wish to develop a quarter-plate, take 2dr. of the former and pour the latter into it until the muddy precipitate first formed is redissolved, the result being a clear solution of a deep orange red colour. Then flow over the plate, adding a little water if necessary to make up the bulk. This will soon bring out the image on the surface of the plate; but a rather prolonged immersion, say a quarter of an hour, or more, is generally requisite to bring the plate up to full printing density; and this you must judge of by holding the plate up against the light and by examining the back, which will be more or less discoloured if the developer has penetrated right through the film. Supposing full density to have been acquired, nothing more is necessary to insure the purity of the whites in printing. In the case of weak negatives various dodges are resorted to, such, for instance, as coating the back of the plate with coloured varnish, and scraping away those parts where the light is required to penetrate deeply. In the case of portrait negatives, where probably little more than the face requires protecting, a good plan is to stipple over the back with a little oil-colour Prussian blue. All "dodging," however, of this description requires considerable practical experience for its proper carrying out; therefore, do not rely upon it, but always, if possible, obtain full printing density in the ordinary way. If you cannot succeed with ferrous oxalate, try pyro.—W. ROBINSON, JUN.

[51666.] — **Cutting Keyways.** — "When one key is employed, its breadth should not be less than ¼ of the diameter of the shaft, thickness equal ⅔ of the breadth, and taper for large shafts ⅛in. in 18in. When three keys are employed, the breadth is ⅙ or ⅕ of the diameter of the shaft, and thickness ⅔ of the breadth." From Binn's "Orthographic Projection."—J. J. D.

[51671.]—**Chimney Flues.**—If the chimney was larger at top than bottom, there would be less friction between the gases and sooty sides of chimney, which is given by Wilson and others as 0·012 in an ordinary chimney; the gases in the chimney cool as they ascend, and move at a slower rate, thus having to be partly forced out of chimney top by difference in weight of atmosphere and heated gases at bottom. If chimney is larger at top the slower rate is taken up by larger area, thus forming no impediment to progress of hotter gases below; but the stability of chimney must be considered. Although chimneys have been built parallel inside and parallel outside, with batter of brickwork inside (none of very large size have been so built), I have never heard of any advantage having been gained; if there was any practical advantage in so having them built, no doubt there would be more in existence than at present.—BOSWELL.

[51673.]—**Bee-Keeping.**—Cut a hole in top of skep, and fit a piece of perforated zinc into, or on to, it, *quite level*; on this put a piece of tin, or zinc, with six or eight fine bradawl holes in, close together. Make syrup of 5lb. sugar, *raw*, to 1qt. water, just to boil. Fill a honey or pickle bottle, and invert this on to tin with holes in. Refill as often as empty. As time is getting short now, a better plan would be to unite them to another stock, if you have any. Write again if you require further information.—J. I. S.

[51674.] — **Decomposition of Water by Electric Current.**—Water may be decomposed by a current from two Bunsen cells, quart size, or by two of Grove's cells (pints). The current from two Bunsens (quarts) is strong enough, and the cost is much less. Bunsen quart cells are about 5s. 6d. each, while Grove pints cost 10s.—W. A. FELTON.

[51674.]—**Decomposition of Water by Electric Current.**—The strength of current is in proportion to the size and number of the battery elements, and also to the resistance of the water to decomposition: when the water is acidified it conducts better, and a stronger current passes. A battery of any kind or size will do for the experiment if it has sufficient electromotive force. Twelve copper or zinc couples, plates 3in. square, six cells, Daniells, or three Bunsens, will be enough; double these numbers are better, as the gases are given off more rapidly. You should make slips of platinum foil ½in. wide and ¾ to 1½in. long, smaller or larger, according to the size of your battery cells. The slips must be soldered to copper wires, then heat them hot enough to melt sealingwax, with which you must cover the soldered joining, and all the wire that is to be immersed. When the platinum pieces are put into the acidulated water within a short distance of each other and connected with the battery, the water will be decomposed.—J. SUTCLIFFE.

[51675.]—**Disinfecting Pictures, &c.**—Any movables, if taken into the open air and well blown on with the kitchen bellows, will be more naturally disinfected than by any method prescribed by the chemist.—T. P.

[51678.]—**Stinking Indiarubber Gaspipe.**—There is no remedy; the rubber is being attacked, and the destruction will go on until the pipe, as a pipe, is spoilt. You should procure the special tube employed for gasfittings. It is covered with several layers of cotton or linen and well varnished. —NUN. DOR.

[51680.]—**Surveying.** — The instructions for measuring the land will, I fear, take too much space for these columns. Hayricks: Take the mean length and width of rick in feet at half the distance from base to the bond above the eaves, and the mean height from base (not ground) to the aforesaid bond; then multiply length by width, the sum by the height, and divide by 27; the result is cubic yards. You must then judge the solidity—i.e., how many cwt. to a square yard; a hard rick has about [illegible], a new rick about 1, to the cubic yards above, say, 60. Add the solidity say at 1½ = 60 + 30 [illegible] 90 [illegible] 20 (i.e., 20cwt.), the result is tons of hay. Or, instead of [illegible] by 27, by 400; the quotient will be loads, the remainder trusses. (A truss of old hay weighs 56lb. new 60lb.) And, if the loads are multiplied by [illegible] trusses in a load) you find about the trusses. The trusses may be found exactly by reduction of content, and dividing by 56 or 60. The foregoing is the plan used by the professional valuer: the following is, I believe, used by many farmers. Instead of dividing by 27, divide the sum by 54 if the solidity is 1cwt.; by 432 if 1¼; by [illegible] if 1½; by 308½ if 1¾, and so on; the quotient is tons. Straw: four-sided ricks as hay. Round stacks: Multiply circumference by diameter, and ÷ by 4; multiply this by height (to eaves). The circumference should be the mean, and the diameter is ⅓ of circumference. And for the roof: Half the circumference under the eaves × half diameter × half height of roof ÷ 3 = contents of roof; add content of stack, and reduce to tons as for hay. Or, half circumference of stack × ½ diam. × by height = content of stack without roof.—H. Hannen.

[51683.]—**Kidney Beans.**—We have repeatedly and without failure preserved beans in the manner indicated by "Kanet." We have just put some down for winter use. Did "Kanet" shred the beans, or were they put in whole? We shred them as for boiling, put in jar, layer of salt, then layer of beans, and so on till sufficient are laid by for winter use. Ours have come out perfectly green and good, and when soaked overnight in water to extract salt, can scarcely be detected from perfectly fresh beans.—[illegible]

[5168[illegible].]—**The Other Side of the Moon.**—Modern science will always be exposed to the badinage of such queries as "W. G. C." till it gives us some more intelligible information upon those special subjects it professes to deal with. Nothing of a reliable nature has yet been furnished us with respect to this luminary. And the same equivocal testimony is all we get from scientists in general. Why should not the moon have a dark as well as a bright side? We see the bright side without any glasses, and with them we can often discern the whole circle, even when she is in her first quarter. If anyone will take the trouble to paint a child's ball half white or black, and slowly turn it round, they will see all the moon's changes very plainly illustrated. The centre of gravity being "eight miles" nearer one side or another, I leave to those who have taken the measure of it. I should not wonder if they were a few yards out.—John Haw[illegible].

[illegible] **Historical.** The exact date is quite uncertain, but there is little doubt it was introduced during the Apostolic age, probably from [illegible] A.D.—W. Robinson[illegible].

[illegible] **Historical.** Haydn's "Dictionary of Dates" states, [illegible] Bede as an authority, that Christianity was taught in Britain about A.D. [illegible], and with success [illegible]. Green and Haydn agree that Augustine landed in [illegible].—[illegible]

[illegible] **Historical.** Gildas, the earliest British historian, says that the religion of Jesus [illegible] at the time of the [illegible] the Romans [illegible] Saltmarsh's [illegible] Church," page [illegible] Chronology," gives the [illegible]

[illegible] **Historical.** In [illegible] A.D. Columba founded [illegible] the Island of Iona, one of the Hebrides, with a chosen band of twelve, who accompanied him from Ireland, whence he came. Columba [illegible] took up his residence with King Brude [illegible] one of the most [illegible], and while there met with a petty prince of the Orkneys, [illegible] an opportunity. By his means [illegible] sent his disciples to the extreme North, and introducing Christianity to the [illegible] then known world.—[illegible]

[illegible] **Photography.** [illegible] "P. C. W." [illegible] "Paget" bromo-gelatine dry plate [illegible] any amount of density he may require. Plates may be intensified with solution of bichloride of mercury followed by a weak solution of ammonia. Nothing can be done in the way of toning a plate after it has been exposed and fixed. The toning bath is good, but the addition of soda is not required after the first quantity. The black deposit indicates a reduction of the gold in the toning bath. I fear "P. C. W." is not careful in using each vessel solely for the one purpose. Does he keep his fingers clean?—[illegible]

[illegible] **Tennis Court.** Pick up the old concrete to the depth of about 2in., and relay with *concrete mixed as follows: Fine sea shingle 3 parts, Portland cement 1 part. If this is put on not 2in. thick, I do not think you will want anything better.*—[illegible]

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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[illegible]	Magnesium, [illegible]
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[illegible]	China Painting, [illegible]
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[illegible]	Induction Coil, [illegible]
[illegible]	Electro Magnet, [illegible]
[illegible]	Salt in Beer, [illegible]
[illegible]	[illegible]

QUERIES.

[illegible]—**Pot-Pourri.**—Can any of your readers oblige me with a recipe for pot-pourri?—H. A. C.

[illegible]—**Royal Arms.**—To Mr. Wetherfield.—Under the new Patent Law, what authority is requisite for the use of Royal Arms, and how obtained? Does the penalty apply to designs in use already, and would informers get any portion? There must be an enormous number of cases where people have labels used for years in stock—very often hundreds of pounds worth—with no written authority procurable, but only a traditionary evidence of supply to Royalty. How will the Act affect such? A reply at earliest convenience will be, I doubt not, a boon to many, as it certainly will to—[illegible]

[illegible]—**Crystoleum Process.**—I have followed out the directions given by your correspondent for painting photographs by the crystoleum process; but find that after a short time they are covered with unsightly spots and patches, and are thereby utterly destroyed in appearance. Is this caused by some defect in the photograph, or in my method of applying materials, or something wrong with the latter? I may state that I have substituted poppy oil for that mentioned in the directions.—[illegible]

[illegible]—**An Excellent Yeast.**—In the English Mechanic of a week or two back I cannot give the exact date appeared a recipe under the above heading, which consists of [illegible] of hops, 1lb. of brown sugar, ¼lb. of flour, a small handful of salt, and 3lb. of raw potatoes, with four quarts of water; and as I am anxious to know of something which will serve as a substitute for the ordinary publicans' barm, that is chiefly used in this neighbourhood, and is often very scarce, and sometimes miserable stuff, I decided to make up and try the above recipe, but the results have been very unsatisfactory; but perhaps the failure was due to the imperfect manner of my carrying out some of the smaller details. In the first place I used what is called the best batch flour, and perhaps I should not have used that sort, and I kept it in a saucepan with the lid on by the side of the fire—which might have been wrong also; and further, I tried it in the same way that ordinary publicans' barm is generally used. But whatever might be the cause, it certainly in its present condition is quite useless. Will the author of the above recipe, or any other kind friend, help me out of my difficulty, and oblige?—E. R. D.

[illegible] **Centre Board.**—I have a 15ft. punt, which is kept on the beach near the sea. Now the beam being [illegible], she has not enough depth of keel to sail well. The keel is about 3in. thick and 4in. deep, with iron all along the bottom. I should like to make a centre-board, lee-board, or something to answer that purpose. It might be fixed and unfixed when the boat is in the water. I have some objections to a centre-board to go right through the keel from the inside in the usual way. If any one would kindly give me a hint, it would greatly oblige—[illegible]

[illegible] **Smoke Nuisance.**—Can any one tell me if there is any way of stopping the black smoke that rolls out of large stacks that several fires run into? Also if there is an apparatus by which you can consume your own smoke?—[illegible]

[illegible] **Levelling Slab for Toning Prints.**—Will any of "ours" kindly instruct me how to make a levelling slab of a simple kind, such as is used by photographers in toning prints?—Tyro.

[51702.] **To "The Kent Hermit."**—On p. 488, last volume, you state that "kind Providence has planted in our gardens a vegetable which will cure every known disease." So far, only the readers of "ours" who are invalids have applied for the information which you so kindly offer. Might I ask you for the information on behalf of those who take an interest in botany (and they must be numerous amongst the readers of the "E. M.")? After carefully watching your replies up to date, I have, in a botanical sense, only noticed one recipe, and that is that asparagus cures rheumatism—Wm. Cowan.

[51703.]—**Arithmetical.**—Would some kind reader solve the following?—A train 635ft. in length running at the rate of 45 miles, overtakes another 565ft. in length, running at the rate of 40 miles. In what time will they be clear of each other, supposing they are running on parallel straight lines?—E. M. H.

[51704.]—**Problem.**—A. and B. built a wall 100 yards in length for C., who paid B. 2s. per yard more than he paid A. C. paid each £50. How much of the wall did each build, and at what rate per yard? Formula wanted such that the answers may be carried to any desired no. of decimals.—Neglected Education.

[51705.]—**Sundial on a Card.**—I have made many of these dials, but have never been able to find out the principle on which the lines are laid down. Can any one or your scientific readers assist me?—G. Roberts.

[51706.]—**Model Boiler.**—I am making a small model horizontal engine—dia. 1in., stroke 2in. Will one of our contributors give me dimensions of a good substantial boiler to work the same?—Nonplus.

[51707.]—**Texas.**—As I am thinking of going out to the State of Texas in a short time, I would feel favoured if any of "ours" would give a general description of the country: such as the climate, people, work to be had, and probable chance of success in life with settling down there latterly? I can get a shepherd's situation there from an acquaintance of my own. I would be about 80 miles from Austin, the chief town, and 200 miles off the sea-coast. I have no money. Is the heat oppressive? How much wool would I get off 100 sheep per year, and what is it worth there? What is the value of 20s. there in contrast to 20s. here in Scotland?—Shepherd.

[51708.]—**Restoring Ink Writing.**—Can any chemist or other among your readers kindly tell me how to restore ink writing that has been bleached and rendered invisible by a fluid apparently a solution of chloride of lime. The fluid is colourless, and about the consistency of glycerine.—W. F. L. Low.

[51709.]—**Telephone Transmitter.**—To Mr. R. W. Hart.—I have an electric bell from my house to place of business. Can I use the same wires, &c., for a telephone by using the transmitter described in 21770 last week? If so, I shall be glad to know where to obtain the carbon necessary. I shall be pleased to give the result of my experiment in the "E. M."—Fred.

[51710.]—**Electric Bells.**—I want more battery power for my electric bells. I have been using one of the old form of the Leclanché with porous cell. Would it answer if I were to add one of the patent Leclanchés to it? If so, must it be same size cell? Also what makes the zincs get so black?—V. M.

[51711.]—**Greenhouse Valves for Hot-Water Pipes.**—In a greenhouse divided into three parts—say A, B, C—the boiler to be placed near where A B join, which is the best plan of heating?—(1) To have separate flowpipes and returns for A and for B C, or (2) to have only one flowpipe and work the other two divisions therefrom? Also, where must the valves be placed so as to heat A only, or A B only? If only one valve at each shut-off, is it on flowpipe or junction, or are two valves necessary at each shut-off?—C. Gravenhall.

[51712.]—**Stone - Setting.**—Will some jeweller kindly give some hints on setting and resetting pearls and stones in rings and other articles of jewellery—such as how to make the minute claws that hold the stone, and how to sink the edge of the hole in the form of a rebate to take the stone? The settings I mean are like a bright star cut in the surface of the ring, and the stone appears to be held by minute claws in the points of the star.—J. E. A.

[51713.]—**Padding Flute.**—I play a Carte-Boehm flute. Sometimes when the pads on valves get worn, and there is a leakage, I have a difficulty in finding out where the defective pads are. Could some reader direct me how best to discover where the leakage occurs? In putting on a new pad, I frequently make it either too thick or too thin. Can I tell the thickness of pad to put on by any other means than by experimenting?—Amateur.

[51714.]—**Removing Ink.**—I have some fine hand-painted gelatine cards. There is writing on the backs of them, which shows through the cards, and mars the effect of the paintings. I have tried to scrape the ink off, but the scraping spoils the cards. Will some reader kindly direct me?—Amateur.

[51715.]—**Fluor Spar.**—I shall be glad if any reader will kindly give me any information respecting fluor spar. I have heard that it is used in the manufacture of glass and for fluxing purposes. Is this so, and what other scientific uses is it put to? Also what is the market value? I have met with a quantity of spar which forms the matrix of a vein; but as the crystals are so imperfectly formed, it is a question with me whether it is fluor or quartz spar. The colour is various, and it is moderately hard. Not having a knowledge of chemistry, I am unable to test it, and should therefore be glad to know a simple method proving what class it belongs to.—Carboniferous.

[51716.]—**Street Lighting.**—Would some reader kindly say whose are the best regulating burners to use on street gas-lamps, and what size burner should be used? Sugg's and Peeble's burners have been suggested. Also if a cheap and effectual reflector can be placed inside an ordinary lantern?—Luminous.

[51717.]—**Lantern Readings.**—I have a magic-lantern. I was thinking as it magnifies pictures, could it not be made to magnify printing? I have a small hand-bill that I should like to show on a small screen about 8ft. square. Can any one tell me how I could put the printing on the slides?—W. Jackson.

[51718.]—**Outdoor Officers of Customs.**—In entering this department of the Civil Service persons commence at £55 a year; the next division above this commences at £85 a year. I should be glad if some one can tell me whether they have to pass same examination to get to the £85 a year? If not, how do they get there? —R. O.

[51719.]—**Water-Motors.**—Can any of your readers give me an explanation of the following fact?—When we connect a hose to a water co.'s main we find that the water issues rather slowly; but let us squeeze the end of the hose and we find that the water issues with sufficient "force" to carry it up to a height of say 10ft. or 12ft., according to the size of the aperture. This fact seems inexplicable to me, because the pressure of the water is the same at every sq. in. in the hose. Will any one give me the rule by which I can find the number of gallons per min. that will pass through a hole of a certain area—the pressure per sq. in. being known? I think these queries will interest many other readers, now that the subject of water-motors are being brought so prominently before us.—Pressure Gauge.

[51720.]—**Electric Launch.**—I want to make an electric launch about 2ft. long. Would you tell me beam and depth, also the best way to set about the machinery? —A Learner.

[51721.]—**Sore Leg.**—Will any humane reader give information on the following case?—I have for some time been suffering from a bad leg, with at times excruciating pain in the calf and foot. There is a sore upon the same, about half-way betwixt the knee and ankle, about the size of a crown piece. The veins about appear knotted, as if from obstruction. I am 64 years of age; fleshy; health generally fair.—J. Dexter.

[51722.]—**Prevention of Rust in Firearms.**—Can any one inform me what lubricant is the best for preventing rust in the interior of gun and rifle barrels when laid by? I have found the much-vaunted vaseline to be a failure in this respect, as however well the barrels may be cleaned before its application, red rust is sure to make its appearance in a short time. Some substance would seem to be required which has a stronger affinity for oxygen than the iron itself. Mr. Allen would perhaps kindly give his opinion?—Rifle.

[51723.]—**Oxide of Copper Battery.**—How many cells are required to work a 5-candle power incandescent lamp? (2) For how many hours would the battery give a continuous current under such circumstances? (3) What is the cost of recharging each cell?—W. W. Sallett.

[51724.]—**Height of Barometer.**—Will some reader tell me what my barometer (aneroid) should stand at, suppose at London it stands 30, as published in the *Telegraph*? We are 238ft. above sea-level?—Norfolk.

[51725.]—**Printing Potato Sacks.**—I should be glad to learn how to print name and trade-marks on sacks, otherwise than by stencil plates? Any information would oblige.—Spuds.

[51726.]—**Boiler for Small Boat or Canoe.**—To "W. E. G."—Will this gentleman oblige me, a fellow reader, by giving the following information?—What size boiler shall I require to drive a vertical double-cylinder engine (slide-valves), 6in. stroke by 3in. bore? I am building a small boat 14ft. long by 2ft. 6in. wide, and am desirous of fixing in her engines as described, if I can get small enough boiler. I want her for speed on a smooth river. I propose fitting two propellers in her, one at bows the other at stern, driven direct by engine crankshaft. The propellers will be sunk at least 6in. under surface of water. I have large screw-cutting lathe and tools suitable for the job. Any information or hints will be thankfully received.—C. F. R.

[51727.]—**Alexandra Beehive.**—Having commenced bee-farming on a small scale this year, the letters which have appeared from time to time in the English Mechanic have interested me very much. As I make a point of doing all the work in connection with the bees myself—that is hive-making and sundries connected therewith—I am during the winter months going to make one or two hives, and as I have read about the perfect accommodation provided in the Alexandra hive, I thought of making one of that pattern, and shall be greatly obliged if some of our practical apiarians will give me such a description, with a drawing, if possible, as will enable me to construct one.—Rojam Semaj.

[51728.]—**Photography.**—Will Mr. Lancaster or any of our readers explain the cause of my failure in taking a picture? I have a ¼-plate camera with a good achromatic lens. My silver bath consists of nitrate of silver ½oz., distilled water 6oz., ¼ drachm of nitric acid, and ¼ grain of iodide of potassium. The plate is coated with Mawson's and Swan's positive iodised collodion, and I use an ordinary iron developer, and fix with a hypo. solution. After the picture is developed and fixed, it appears as if someone has smeared it with their hands, and afterwards fades away altogether. Would be much obliged if someone would take an interest in the matter. —E. F. Terrey.

[51729.]—**Electric Engine.**—Will some kind reader tell me if a motor with a Siemens' armature is self-starting? If so, could I make one with an armature 2 or 3in. long? If I can get one to move it will suit my purpose. If not self-starting, can you tell me any small sort, that is to work with small battery power? Also state quantity of wire.—W. G. Bennett.

[51730.]—**M.R. Locos.**—Wanted dimensions of 201, 200, 2061, 221A, 140, 887, 195, 200A, 603, 1123, 1093, and 1635, and stations of 40, 45, 75, 85, 150, 230, 250, 257, 259, 446, 538, 606, 680, 712, 786, 877, 878, 991, 1076, 1082, 1177, 1184, 1318, 1320, 1331, 1340, 1342, 1344, 1368, 1440, 1463, 1475, 1565, and 1567.—J. E. Spencer.

[51731.]—**Liability to Repair Road.**—To Mr. Wetherfield.—A. is the owner of two houses, the street in which they are situated being in very bad order. The local board repaired it. A. has to pay his share for repairing, but does not do so. Eighteen months after A. sells the houses to B. Six months after the purchase B. gets the bill for reparing sent to him. Can they compel him to pay it?—C. B.

[51732.]—**Crystoleum.**—Could some reader kindly oblige with the sort of varnish, or a recipe for one, for fixing prints to glass for crystoleum work? Also means of making them transparent? Ought they to be made transparent before or after fixing to the glass. A few hints on the crystoleum process will be very acceptable.—Novice.

[51733.]—**Retouching Negatives.**—I should feel much obliged to Mr. Lancaster or any other kind reader if he would give me some information on retouching negatives. I have Le Meritoire camera, &c., which I must say works admirably; but a friend or two have informed me my negatives require retouching, which I do not understand.—Amateur Photo.

[51734.]—**Scum Cock.**—What is the proper height to fix scum cock with regard to the working level of water? Which end ought it to be fixed—over the furnace, or the other? The boiler horizontal, external fired.—W. W. Evers.

[51735.]—**Boat.**—Will any reader assist me with full-size section drawings of a 12ft. by 3½ft. deep draught centre board sailing boat? I mean the shape of hull at say nine different points from stem to stern. I have drawings on 1½in. scale, but do not know how to take off full size.—Sir W. Waller.

[51736.]—**Mechanics.**—(a) Given length and time of (single) vibration of a simple pendulum. Find its amplitude. (b) Find the length of a pendulum which makes a single vibration in 1½ seconds ($g = 32$). Will any of "ours" kindly work out the above without the direct employment of textbook formulæ? We cannot follow the reasoning in Deschanel and Twisden. Has centrifugal force any further effect than a pull on the point of suspension?—Befogged Science Students.

[51737.]—**Engineering.**—Will any of your professional readers favour me, as one of the fathers interested in the practical question—"What shall we do with our sons?" with a little information as to the course usually adopted in training youths for the engineering profession? The alternative used to be—serve five or more years in the shops, or pay a premium, varying with the standing of the firm selected, in order to avoid some of the manual labour. I should like to know how far the rise of modern science colleges, which include a department for the practical teaching of this subject, has modified the old practice, and what terms are usually imposed on a youth who has passed the course at one of these institutions. Also, what is the system pursued at the works of our largest railway companies for recruiting their engineering staff?—X. Y. Z.

[51738.]—**Laundry Stove.**—Can any practical reader tell me if a stove with the flue at the back gives as much heat, and has as much draught, as a stove that has its flue at the top?—Laundryman.

[51739.]—**Waterproofing Sheets.**—Having observed the recipe for waterproofing sheets for covering waggons, I shall be glad if someone will tell me if it is a good one, and if it would do for putting over several sheets I have which are showing wear at the creases, and if it can be obtained already mixed: 95 gallons of linseed oil, 8lb. of litharge, 7lb. umber, boiled together 24 hours —coloured with 8lb. vegetable black.—Ramchullunder.

[51740.]—**Pills.**—Will some reader kindly inform me how the above are coated with silver and sugar.—Brown.

[51741.]—**Fixing Pipes to Harmonium.**—Will Mr. Fryer or some other reader kindly tell me how I can fix some organ pipes to a French harmonium (one of Alexandre Fils')? I propose making the pipes of paper. A few remarks as to tuning the pipes will oblige—Chemicus.

[51742.]—**Induction Coil.**—I am making a coil of following dimensions:—Core, 9in. long, ¾in. diam.; primary, two layers of No. 16; ebonite tube, 8in. long; central disc, 6in. diam. Having wound 1lb. of No. 36 (properly insulated) on one end of tube according to my original intention, I find 1¼in. distance left between outer layer of wire and edge of disc. I shall be glad to know (1) if the core and primary will allow more secondary; if so, (2) to what distance from edge of disc it will be safe to wind secondary; (3) the best battery for the coil when finished.—X. U. C.

[51743.]—**Staining.**—I have a large room that I wish to have stained a rather dark oak about 2ft. from the surbase to meet carpet, and want to know how I should do it, as I think I have seen painters use the stain with oil in it, which does not require varnishing afterwards.—Beta.

[51744.]—**Brazing Bicycle Head into Hollow Back.**—I have a hollow backed bicycle with a malleable cast iron head brazed for 2in. into the tube forming the hollow back, and then fastened with a pin passing through the tube and head. I wish to put a new head into the tube. Will some fellow-reader tell me how to braze it in after I have fitted it?—H. Jamieson.

[51745.]—**Voice Missing.**—I have suffered at intervals during the last two years from losing my voice. The first time was from over-exertion in blowing. I thought I had quite recovered about six months back, but a fortnight back I caught cold and my old complaint has returned. The most peculiar feature is that it goes or comes instantly; for instance, yesterday until about 11 o'clock I could only speak in a rusty whisper, when all at once my voice came and remained until evening, when I lost it again. What is the cause and cure.—R. S. Lladnar.

[51746.]—**Weak Ankles.**—I should take it as a favour if any of "ours" would inform me if an elastic stocking would make my ankles stronger, or I should be thankful for any other suggestions as to bathing them.—Brunswick.

[51747.]—**Coal Saver.**—Can any correspondent tell me if there has been an arrangement for saving coals like the following?—A number of flat pieces of sheet iron are placed obliquely behind the fire, and by some arrangement is supposed to send the heat into the room.—Brunswick.

[51748.]—**To Mr. Wetherfield.**—Will you kindly state, for the benefit of our readers in general, and for myself in particular, if under the judgment of the suit Dobbs v. Grand Junction Water Company consumers are justified in refusing to pay their water rate except on the scale of their parish assessment and not on the actual rent paid, as a deal of haziness exists in this matter, and the water collectors continue to demand the rates based on the higher scale. Thanks in anticipation.—Aqua.

[51749.]—**Motor.**—Will any reader kindly inform me if the pole pieces of a Siemens' armature would be at all affected by having steel flanges instead of brass? The armature of my motor has steel flanges, and I cannot make it work.—F. W. Leake.

[51750.]—**Washing Negatives.**—I should be obliged if some of our readers would kindly state what length of time they find it necessary to wash or soak their plates after development. I use well water, having no running supply of water. After developing I place the plate in water in a china dish, and allow to soak for ten or fifteen minutes, changing water five or six times. I then place plate in alum solution, and after that again wash plate same as before. I should like to know whether so much washing is necessary.—Rex.

[51751.]—**Pendulograph.**—How is this instrument constructed and used? I should feel greatly indebted for a full explanation, and a sketch would probably interest many readers besides the writer. The opticians are showing the most complicated and delicately traced designs made by its means, and some said to be produced by soundwaves. These productions are so beautiful that many would be interested in a practical exposition of the process.—J. L. M.

[51752.]—**Tricycle Making.**—I intend making a tricycle during the coming winter, and shall be glad if any reader who understands such things will tell me which type of machine would be most suitable for an amateur to make. I was thinking of one like Singer's Folding Challenge—that in which there is one large wheel behind the rider. This seems to me to offer the greatest advantages for an amateur mechanic, but I should like to have the opinions of others. Whatever machine I decide upon making, I hope Mr. Editor will find room for full detail drawings of it.—Grapho.

[51753.]—**Sugar, Agent in Decolourising.**—Can any correspondent tell me what is the acting agent in animal charcoal in decolourising sugar solutions?—Sugar Refiner.

[51754.]—**Agriculture.**—What is a fair average weight of mangolds, swedes, turnips, and carrots per acre? What is the average value when mature per acre and per ton?—Estate Agent.

[51755.]—**Legal—Medical Electrician.**—I beg to thank "Lex" for reply to query contained in "E.M." of the 24th ult. B., however, maintains that although the cures (for which the testimonials in question were given) were effected by A., the testimonials are the property of B. for the reason that A. was in B.'s employ at the time. A., however, contends that the skill by which the said testimonials were obtained being his (A.'s) absolutely, and having subsequently severed his connection with B., the testimonials are his (A.'s) property, B. having no possible right to set up such testimonials as evidence of his skill, seeing that he had nothing whatever to do with the treatment of the case for which the testimonials were given. The further reply of "Lex" on the rightful ownership of the testimonials will greatly oblige —Justice.

[51756.]—**Cartridges for Martini Henri.**—Will any reader of "ours" inform me with what powder the Martini Henri rifle cartridges are loaded, and what weight of powder (in drachms) used?—Thos. H. Hall.

[51757.]—**Bradford's Washing Machinery.**—Having been in the laundry line for some time, and heard a good deal of Bradford's machinery, I had the opportunity to buy a large Bradford's washing machine (second hand) the other day. Would some reader who has had practical experience in the above tell me how to go to work, as I have entirely failed to get the clothes clean, although I have kept close to the instructions furnished by the maker? I have given the clothes a good firsting for about ten minutes, and a seconding in nearly boiling water for about the same time, but still all the dirtiest parts have to be done by hand afterwards, which is a great loss and what I do not need to do after the other machines I have; but they are on a different principle and different maker.—One in a Fix.

[51758.]—**Fyfe-Main Arc Lamp.**—Would any reader kindly give a description of the Fyfe Main (standard) arc lamp? A sketch will oblige—Toluol.

[51759.]—**Escapement.**—To "R. E. B."—Will you kindly inform me why the verge escape-wheel teeth do not require oil? Also, why oil should not be applied to the impulse-pin of the lever escapement?—C. Bohn.

[51760.]—**Shoe Repairing.**—Will some practical reader of "ours" kindly answer the following?—I can make both rivet and pegged shoes, but cannot make sewn work. I have sewn two pairs of soles on, but my work rips soon after wearing. (1) What is the best hemp to use? (2) The best size awl and thread. (3) Am I to sew in the same line with former stitches or nearer the edge of welt? (4) Am I to hammer the leather before or after sewing it on? I have to fill up my time with repairing.—Crispin.

[51761.]—**Magneto Machine.**—I wish to make a magneto-electric machine for giving shocks. If one of "ours" can give me a rough sketch with proportions I should feel obliged.—T. F.

[51762.]—**Motor for Dynamo.**—I have a small dynamo that requires the power of about two men to drive properly. I had an idea that a water motor of about that power would drive it; but not having seen such a thing in motion, I thought perhaps it would not rotate quickly enough. I then thought if I made the pace quicker by using three cog-wheels I should lose a considerable amount of power. I have a cistern 50in. by 39in. by 32in., and it is 25ft. above the ground. Should I get pressure enough to work a motor properly? Would any of your readers advise me as to the best way of going to work in the matter?—Motor.

[51763.]—**Dividing Engine.**—Can any of your correspondents give me working particulars of the mechanism of the dividing engine? The part that bothers me is the

ASTRONOMICAL NOTES FOR OCTOBER, 1883.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 49 43·82 ,,	12 29 14	3 9 33	12 39 30·38
6	11 48 12·28 ,,	12 47 25	5 5 35	12 59 13·14
11	11 46 50·12 ,,	13 5 46	7 0 0	13 18 55·91
16	11 45 39·62 ,,	13 24 18	8 52 1	13 38 38·67
21	11 44 43·54 ,,	13 43 5	10 40 53	13 58 21·43
26	11 44 4·34 ,,	14 2 8	12 25 49	14 18 4·20
31	11 43 43·68 ,,	14 21 31	14 5 57	14 37 46·97

The method of ascertaining the Sidereal Time at Mean Noon at any other Station will be found on p. 373 of Vol. XXXVI.

The Zodiacal light may now be seen in the East before sunrise.

Spots, faculæ, and other indications of Solar disturbances continue.

There will be an Eclipse of the Sun on October 30th; but, as it will be invisible in this country, it will suffice merely to mention it here.

The Moon

Is new at 5h. 54·3m. in the early morning of the 1st, and enters her First Quarter at 10h. 19·6m. a.m., on the 9th. She will be Full at 6h. 45·4m. a.m., on the 16th; enter her Last Quarter at 11h. 18·6m., on the night of the 22nd; and be New, for the second time this month, 3·2 minutes before midnight on the 30th. The tides may be expected to be rather high about the 16th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	0·3	Noon.
6	5·3	3 42·7 p.m.
11	10·3	7 53·0 ,,
16	15·3	12 25·6 ,,
21	20·3	4 23·9 a.m.
26	25·3	8 29·7 ,,
31	0·5	0 6·5 p.m.

The Moon will be in conjunction with Venus at 3 p.m. on the 1st; with Mercury 12 hours later; with Saturn at 9 a.m. on the 19th; with Jupiter at the same hour on the 23rd; with Mars at Noon on the 23rd; with Mercury again at 3 p.m. on the 29th; and lastly with Venus (also for the second time this month) at 11 o'clock on the night of the 31st.

There will be

A Partial Eclipse of the Moon

during the Early Morning of October 16th, but the Moon will set a little before the middle of it. We give the details adapted from the *Nautical Almanac.*

First Contact with the Penumbra, October 16th, 4h. 42·4m. a.m. First Contact with the Shadow, 5h. 59·1m. a.m. Middle of the Eclipse, 6h. 54·3m. a.m. Greenwich Mean Time.

Magnitude of the Eclipse (Moon's diameter = 1) 0·277.

The first contact with the shadow occurs at 132° from the Northernmost point of the Moon's limb towards the East.

The Moon will set at Greenwich at 6h. 25m. a.m.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
4	III	Ec D	4	56	19 A.M.
6	II	Ec D	2	41	59,,
6	IV	Ec D	3	41	14,,
6	I	Ec D	4	20	13,,
7	I	Sh I	1	31	,,
7	I	Tr I	2	45	,,
7	I	Sh E	3	50	,,
7	I	Tr E	5	4	,,
7	*III*	*Tr I*	11	51	P.M.
7	*II*	*Tr I*	11	56	,,
7	*II*	*Sh E*	12	17	,,
8	I	Oc R	2	20	A.M.
8	II	Tr E	2	49	,,
8	III	Tr E	3	21	,,
8	*I*	*Tr E*	11	33	P.M.
13	II	Ec D	5	18	21 A.M.
13	*I*	*Ec D*	6	13	20,,
14	I	Sh I	3	24	,,
14	I	Tr I	4	40	,,
14	*I*	*Sh E*	5	43	,,
14	II	Sh I	11	58	P.M.
14	IV	Tr I	12	1	,,
14	I	Ec D	12	41	37 P.M.
15	III	Sh E	2	15	A.M.
15	II	Tr I	2	33	,,
15	II	Sh E	2	50	,,
15	III	Tr I	3	56	,,
15	I	Oc R	4	15	,,
15	IV	Tr E	4	15	,,
15	II	Tr E	5	26	,,
15	*I*	*Tr I*	11	9	P.M.
15	I	Sh E	12	12	,,
15	I	Tr E	1	29	A.M.
16	II	Oc R	12	4	P.M.
21	I	Sh I	5	18	A.M.
21	*I*	*Tr I*	6	35	,,
22	II	Sh I	2	31	,,
22	I	Ec D	2	34	42,,
22	III	Sh I	2	48	,,
22	II	Tr I	5	8	,,
22	II	Sh E	5	24	,,
22	*I*	*Oc R*	6	9	,,
22	*III*	*Sh E*	6	13	,,
22	I	Sh I	11	47	P.M.
23	I	Tr I	1	4	A.M.
23	IV	Ec R	1	26	41,,
23	I	Sh E	2	6	,,
23	I	Tr E	3	23	,,
23	I	Oc R	12	37	P.M.
24	II	Oc R	2	43	A.M.
26	III	Oc R	1	29	,,
29	I	Ec D	4	27	46,,
29	II	Sh I	5	4	,,
29	*III*	*Sh I*	6	47	,,
30	I	Sh I	1	40	,,
30	I	Tr I	2	58	,,
30	I	Sh E	3	59	,,
30	I	Tr E	5	17	,,
30	*I*	*Ec D*	10	56	3 P.M.
30	II	Ec D	11	49	47,,
31	I	Oc R	2	30	A.M.
31	II	Oc R	5	19	,,
31	*IV*	*Sh I*	6	4	,,
31	*IV*	*Tr E*	10	26	P.M.
31	*I*	*Sh E*	10	28	,,
31	I	Tr E	11	46	,,

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Mercury

Is an Evening Star at the beginning of October; but comes into Inferior Conjunction with the Sun at 1 a.m. on the 7th, after which he, of course, becomes a Morning Star. He pursues his westerly path (as regards the sun) up to noon on the 22nd, when he attains his Greatest Elongation West (18° 16′) and commences his return journey. His angular diameter, which is 10·2″ at the date of his Conjunction, decreases to 5·6″ by the end of October. He is by no means well placed for the observer.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 6·3	10 40·0	0 26·7 p.m.
6	12 52·3	8 15·9	11 49·3 a.m.
11	12 31·8	3 58·2	11 13·0 ,,
16	12 27·3	1 53·2	10 48·8 ,,
21	12 37·8	2 4·5	10 39·7 ,,
26	12 59·0	4 1·0	10 41·2 ,,
31	13 25·9	6 53·4	10 48·3 ,,

The pendulum-like path indicated by the above ephemeris lies wholly in Virgo. At 3 p.m. on the 4th, Mercury and Venus will be in conjunction. He will also be in conjunction with γ Virginis (1° 8′ South of that Star) at 7 p.m. on the 20th; but, of course, below our horizon.

Venus

Is an Evening Star—i.e., she souths after the sun; but as she is close to him, and both rises and sets practically in daylight during the whole of October, we defer for another month an ephemeris which would only occupy space needlessly.

Jupiter

Is a Morning Star; but as he rises soon after 11h. 30m. at the beginning of October, and about 10 p.m. at the end of it, we resume our ephemeris of him. His angular diameter continues steadily to increase, from 33·5″ on the 1st to 36·6 by the 31st. At 7 a.m. on the 27th he is in so-called Quadrature with the Sun.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	8 11·6	20 15·6	7 32·8 a.m.
6	8 14·4	20 7·4	7 16·0 ,,
11	8 17·1	19 59·8	6 59·0 ,,
16	8 19·4	19 52·8	6 41·6 ,,
21	8 21·5	19 46·6	6 24·1 ,,
26	8 23·4	19 41·3	6 6·3 ,,
31	8 24·9	19 36·9	5 48·1 ,,

This short path lies wholly in a blank part of the Constellation Cancer. The Conjunction of Jupiter with Mars (below our horizon) has been referred to under the head of the last-named planet.

Mars

Continues to be a morning star in so far as his Southing is concerned; but he rises about 10h. 50m. p.m. at the beginning of the month and soon after 10 at the end of it, so that he can be fairly well seen during the early morning hours. His angular diameter, albeit it increases from 7·6″ on October 1st to 9″ by the 31st, is still too small to render telescopic scrutiny of his disc of any avail; in fact, it will not be until quite the end of the year that anything in the shape of Areographical detail will be visible.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 39·5	22 19·8	7 0·8 a.m.
6	7 51·2	21 56·9	6 52·8 ,,
11	8 2·5	21 32·3	6 44·4 ,,
16	8 13·5	21 6·2	6 35·7 ,,
21	8 24·0	20 39·2	6 26·5 ,,
26	8 34·0	20 11·7	6 16·9 ,,
31	8 43·6	19 44·3	6 6·8 ,,

Hence it will be seen that Mars will travel from Gemini into Cancer. No star more conspicuous than δ Cancri lies in his path, but he will be found rather more than 2° north of this on the 28th. He will be in conjunction with Jupiter, and only 59′ north of that planet at 7 p.m. on the 19th.

Saturn

Is a Morning Star, too, reference being had to his Transit after Midnight; but he rises at 8 p.m. at the beginning of October, and about 6 in the evening at the end of it. Hence, he is visible during a considerable portion of the w hours of the night. His angular di

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
18	B.A.C. 1272	6	7 48 p.m.	Bright	75	36	8 35 p.m.	Dark	307	267
19	63 Tauri	5	4 5 a.m.	Bright	46	70	4 52 a.m.	Dark	322	354
21	λ Geminorum	3½	12 1 p.m.	Bright	95	55	1 2 ,,	Dark	256	216
24	κ Cancri	5	1 52 a.m.	Bright	102	63	2 50 ,,	Dark	230	193
30	30 Sextantis	6	†3 18 ,,	N.N.W.	341	303				

† A near app

increases from 17·4″ to 18″ during the month, and a similarly imperceptible opening of his rings takes place.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	4 35·0	20 1·6	3 56·8 a.m.
6	4 34·5	20 0·1	3 36·7 ,,
11	4 33·9	19 58·2	3 16·5 ,,
16	4 33·2	19 56·0	2 56·0 ,,
21	4 32·2	19 53·6	2 35·4 ,,
26	4 31·1	19 50·8	2 14·6 ,,
31	4 29·9	19 47·8	1 53·7 ,,

This short retrogade arc lies in the barren region some 3° or 4° North of Aldebaran.

Uranus

Is invisible; but

Neptune,

Although he does not south until the early morning, is yet fairly visible all night long, and is coming into an excellent position for the observer who may care to scrutinise a tiny disc resembling that of a very small 7th magnitude star, in the telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 15·2	16 12·4	2 37·2 a.m.
6	3 14·8	16 10·6	2 17·2 ,,
11	3 14·3	16 8·8	1 57·0 ,,
16	3 13·9	16 6·8	1 36·9 ,,
21	3 13·4	16 4·7	1 16·8 ,,
26	3 12·8	16 2·1	12 52·5 p.m.
31	3 12·2	15 59·9	12 32·3 ,,

From which it will be seen that Neptune is situated in that blank region of the sky to the south and east of δ Arietis.

Shooting Stars

May be looked for from the 1st to the 6th. The chief shower during the month, however, is to be expected between the 18th and the 21st.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of October 1st, 1883.

Star.	Souths. h.	m.	s.	
δ Aquilæ	6	39	2·99	p.m.
Altair	7	4	27·50	,,
α² Capricorni	7	30	52·78	,,
α Cygni	7	56	40·96	,,
α Cephei	8	34	55·94	,,
α Aquarii	9	18	48·01	,,
Fomalhaut	10	10	4·44	,,
Markab	10	17	48·17	,,
δ Sculptoris	11	1	34·78	,,
α Andromedæ	11	21	2·73	,,
α Cassiopeiæ	11	52	31·06	,,
β Ceti	11	56	18·80	,,
Polaris	12	35	49·87	,,
ο Piscium	12	57	39·03	,,

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List on any other night in October, as also that of determining the Local Instant of its meridian passage at any other Station, will be found on p. 375 of Vol. XXXVI. It must be noted, however, that the rules there given are not rigidly accurate when applied to Polaris or any other tolerably close circumpolar star. They will probably, though, be found sufficiently so in practice.

RECENT RESEARCHES ON THE DISTANCE OF THE SUN.

THE Friday evening discourse during the meeting of the British Association was delivered by Prof. R. S. Ball, Astronomer Royal for Ireland. The following is the substance of his remarks:—

The problem which is to engage our attention this evening has been justly regarded as one of exceptional interest and importance. When we have learnt the distance of the sun we can measure the bulk of the sun and his diameter, we can measure the great planet Jupiter or the rings of Saturn, and the scale of the whole solar system becomes known to us. Again, when we attack the loftiest problem in practical astronomy, and seek to stretch a sounding line over the vast abyss which divides our system from the stars, it is the distance of the sun which we must use as our measuring rod. No pains should be spared to give to so fundamental a unit all the precision of which it is capable. Let us define accurately the magnitude to be measured. The actual distance from the earth to the sun is not constant. In these autumnal months the distance is rapidly decreasing. We are at this moment drawing nearer and nearer to the sun at the rate of a thousand miles an hour. Next Christmas we shall be about a million and a half miles closer to the sun than we are to-night. At the commencement of the new year we shall begin to recede. Next midsummer will find us as far from the sun as possible; then we shall draw in again, arrive next autumn where we are this autumn, and commence anew the cycle of changes I have indicated. Though these changes amount to millions of miles, yet they are at the utmost only a small fraction of the sun's distance. To superficial observation the sun always seems the same size, and hence there can be no great relative changes in its distance. There is no difficulty in understanding what is meant by the average distance of the sun. To express the idea with precision we may borrow the language of mathematics, and say that the distance from the earth to the sun consists of two parts—a large constant part and a small periodical part. The important problem, and the difficult problem, is the measurement of the large constant part. This is the question to be discussed in my lecture this evening. The early history of the subject is as easy to sketch as the latter part is difficult. For 14 centuries the doctrines of Ptolemy were adopted on the distance of the sun as on all other astronomical problems. The method of Ptolemy might have succeeded if the sun's distance could have been measured by thousands of miles instead of by tens of millions. As matters stand, Ptolemy's method was utterly inadequate to cope with the real difficulties of the question. It led him to a conclusion which we now know to have fallen far short of the truth. The real distance of the sun is twenty times as great as that which Ptolemy deduced from his observations. But Ptolemy's result was a great step in advance notwithstanding the tremendous error by which it was vitiated. The illustrious Huyghens, in the 17th century, hazarded a speculation, which seemed plausible at the time, and which we now know to have been reasonably correct. Huyghens compared the diameter of the planet Mars with the sun. He compared the diameter of Venus with the sun. The primitive instruments used were capable of making these measures with some accuracy. Huyghens knew that the earth was also a planet revolving outside the path of Venus and inside that of Mars. Was it not reasonable to assume that the bulk of the earth might be comparable with that of its fellow planets, and intermediate between the bulk of Venus and that of Mars? This assumption—and, of course, it was no more than an assumption—gave the means of guessing the distance of the sun, which was concluded to be about 100 million miles. When guesswork came to be replaced by measurement this estimate of the sun's distance was corrected. It was found to be too large. It was amended first to 95,000,000 miles then to 91,000,000 miles. This was subsequently found rather too small, and it is now generally thought that the sun's distance must be more than 92,000,000 miles but hardly so much as 93,000,000 miles. We have here a range of one million miles. The problem in its present condition can now be distinctly stated. We require to determine the sun's distance accurately to within 100,000 miles, or, to speak in round numbers, we desire to determine the distance of the sun accurately to one-thousandth part of its total amount. Is such a degree of accuracy obtainable? I believe that it is. I do not say that the problem has already been solved with this precision, but an approach has been made, and enough has been done to show that the accuracy I have indicated may be attained. But this margin is not really large when we reflect on the stupendous magnitude of the sun's distance. There are certain conditions which any method of measuring the sun's distance must fulfil. In the first place, it is obvious that we cannot measure the distance directly. We cannot take a tape and measure it as we would the length of a field. We are compelled to resort to indirect methods. In other words, instead of measuring the sun's distance directly, we measure something else, from which we derive the sun's distance by calculation. Whatever that something else may be there is one obvious condition which must be fulfilled. The method by which the calculation is to be made must be absolutely unimpeachable. The measurable quantity and the sun's distance must be connected together by inexorable logic. The theory may be difficult, but it must contain no trace of ambiguity or of indefiniteness. No question of mere judgment or of estimation should be admissible. The connection between the two results must be as tight as a demonstration in geometry. It has often been observed that at a meeting of the British Association the proceedings assume a certain tone in harmony with those branches of science with which our President for the time being has been specially identified. In recognition of this principle, which is both useful and appropriate, the first method which I shall allude to this evening is the exquisitely-beautiful mathematical calculation by which the distance of the sun can be elaborated from ordinary observations of the planets systematically conducted at our national observatories. This method was foreshadowed in the dynamical theory of Newton, and was wrought to perfection by Leverrier. It is based upon the great law of gravitation, and is intimately connected with the splendid discoveries in planetary perturbation which form so striking a chapter in modern astronomical discovery. There is a certain relation between two quantities, which, at first sight, seem quite independent. These quantities are the mass of the earth and the distance of the sun. It follows from the measurements of the intensity of gravitation on the earth's surface and from the known revolution of the earth around the sun that the sun's parallax has a determined ratio to the cube root of the mass of the earth. There is no uncertainty about this result, and the consequence is obvious. If we have the means of weighing the earth in comparison with the sun, then the distance of the sun can be immediately deduced. How, then, are we to place our great earth in the weighing scales? This is the problem which Leverrier has shown us how to solve, and he does so by invoking the aid of the planet Mars. If Mars in his revolution around the sun were solely swayed by the attraction of the sun, he would, in accordance with the well-known laws of planetary motion, follow for ever the same elliptic path. At the end of one century, or even of many centuries, the shape, the size, and the position of that ellipse would remain unaltered. Fortunately, for our present purpose, a disturbance in the orbit of Mars is produced by the earth. Although the mass of the earth is so much less than that of the sun, yet the earth is still large enough to exercise an appreciable attraction on Mars. The ellipse which Mars follows is not always the same. The shape of that ellipse and its position gradually change and the position in which the planet is found depends upon the mass of the earth. The place in which the planet is found can be determined by observation; the place which the planet would have had if the earth were absent can be found by calculation. The difference between the two is due to the mass of the earth, and when it has been measured the mass of the earth can be ascertained. The amount of displacement increases from one century to another; but, as the rate of growth is small, ancient observations are necessary to enable the measures to be made with accuracy. A remarkable occurrence, which took place more than two centuries ago, enables the place of Mars to be determined with great precision. On the 1st of October, 1672, three independent observers witnessed the occultation of the star ψ Aquarii by the planet Mars. The place of the star is known with accuracy, and hence we are provided with the means of accurately defining the point on the heavens occupied by Mars on the day in question. From this result, combined with the modern meridian observations, we learn that the displacement of Mars by the attraction of the earth has, in the lapse of two centuries, grown to about five minutes of arc (294 seconds). It has been maintained that this cannot be erroneous to the extent of more than a second, and hence it would follow that the earth's mass is determined to within one three-hundredth part of its amount. If no error were present this would give the sun's distance to about one nine-hundredth part, which approaches very closely to the limit we have indicated. Notwithstanding the intrinsic beauty of this method, and the very high auspices under which it has been introduced, it will, I think, hardly be found to fulfil all the needful conditions. We make no impeachment of the fidelity of the observations, and we feel no doubt that the displacement of the planet is mainly, if not entirely, due to the disturbing effect of the earth's attraction; but it seems quite impossible to be sure that some other cause, minute though it must be, may not also have contributed to the result. We cannot be absolutely sure that the theory is above suspicion. Interesting and beautiful though this method may be, we must rather regard it as a striking confirmation of the law of gravitation than as affording an accurate means of measuring the sun's distance. Several other methods have been employed by which we can place the earth in the weighing scales. Perhaps none of these methods is free from objection as a means of measuring the sun's distance. I must, however, mention one of them which has special claims on our attention of a very peculiar kind. This time we invoke the aid of that erratic member of our system known as Encke's comet. The comet completes a circuit around its ellipse in a period but little more than three years. It does not, however, move with uniform velocity. Around this remote part of its path the comet creeps languidly; but as it turns round and commences to approach the sun the pace gradually improves, and the comet itself swells up in dimensions and in splendour. Encke's comet, although so famous, is one of that numerous host of telescopic objects which seldom or never become bright enough to be visible to the unaided eye. It would, however, be unwise to assign much weight to the distance of the sun, which may be deduced from these researches. Notwithstanding the labours of many astronomers, the theory of the comet's motion is still not sufficiently perfect for this purpose. It cannot be pretended that this method would give the sun's distance to within a thousandth part, and accordingly this method must give place to those which have more claims to accuracy. One of the most celebrated methods of measuring the distance of the sun is derived from a combination of experiments on the velocity of light with astronomical measurements. This is a method of very great refinement and beauty, and although it does not satisfy all the necessary conditions, it is impossible in this lecture to avoid a brief reference to an investigation so remarkable. The principle of this method is easily enunciated. Though the velocity of light is stupendous, yet it has been possible to measure that velocity by experiment. The best determinations indicate that a ray of light would flash over a distance equal to seven times the circumference of the earth in a single second of time (300,400 kilomètres). A ray of light would travel from Southport to London in about the thousandth part of a second. The dimensions of the solar system are, however, so considerable that even a sunbeam requires an appreciable interval of time to span the abyss which separates the earth from the sun. Eight minutes is approximately the duration of the journey. In fact, if the sun were to be suddenly blotted out it would still be seen shining brilliantly for eight minutes after it had really disappeared. Viewed as a means of measuring the sun's distance, it would be necessary to determine this interval accurately to half a second. Does astronomy hold out any prospect of our being able to measure this interval with such nicety? This question is intimately connected with two of the most brilliant discoveries in the annals of astronomy. Although they are well known to every one who has paid any attention to this science, yet I must refer to them briefly to examine how far they admit of the needful precision. Everyone who has had the opportunity of using an astronomical telescope is familiar with the exquisite system of four moons which grace the great planet Jupiter. These little bodies led 200 years ago to the discovery of the velocity of light. In their frequent revolutions the little satellites plunge occasionally into the vast and dense shadow thrown by the mighty planet. The sun's light which had previously rendered the little satellite a glittering point of light is then cut off, the satellite becomes invisible, and we say that it is eclipsed. This is a most pleasing phenomenon to witness, and as the satellites revolve so rapidly, the eclipses occur with great frequency. From the discussion of previous observations of the satellites we have become aware of the nature of their movements, so that the advent of eclipses can be predicted, and even the time of their occurrence. But the time at which the eclipse takes place is not identical with the moment at which we see the eclipse. If we could calculate the moment when the eclipse really took place, and if we could observe the moment at which the eclipse is seen, the difference between the two gives the time which the light occupies on the journey. At both extremities of the process there are characteristic sources of uncertainty. The occurrence of the eclipse is not an instantaneous phenomenon. The little satellite is large enough to require an appreciable time in crossing the boundary which defines the shadow, so that the observation of an eclipse is not sufficiently precise to form the basis of an important and accurate measurement. Still greater difficulties accompany the attempt to define the true moment of the occurrence of the eclipse as it would be seen by an observer in the vicinity of the satellite. For this we would require a far more perfect theory of the movements of Jupiter's satellites than is at present attainable. This method of finding the sun's distance holds out no prospect of a result accurate to the one-thousandth part of its amount, and therefore we may discard it. But there is yet another method by which the experimental determination of the velocity of light can be so combined with purely astronomical measurements as to yield the sun's distance as a result. Time will not permit that I should enter into this subject, which is identified with one of the most glorious discoveries of astronomy—namely, the aberration of light. But here I would only remark that this method does not fulfil the condition of geometrical necessity. It has not even the somewhat inferior attribute of dynamical necessity. The physical conceptions introduced may to some degree be open to question. Is it certain that the velocity of light [illegible] is the same as the velocity of light through [illegible]? Is it certain that the motion of the whole solar system can be suitably allowed for and eliminated? The time has not yet arrived when these latter questions can be fully answered. The most accurate method of measuring the distance from the earth to the sun is without doubt that which is afforded by the transit of Venus. This has engrossed more attention than all the other methods together. On four occasions the attempt has been made to find the sun's distance by its aid; the last of these occurred only last December, and another opportunity will not occur until June in 2004. It was formerly supposed, and it is, no doubt, still maintained by many, that the transit of Venus is *par excellence* the method, but the growth of practical astronomy has tended to question the supremacy of the transit of Venus. An attack has been made in two distinct directions. It has on the one hand been shown that the transit of Venus is incapable of the accuracy that was at one time claimed for it. On the other hand, the new method by the aid of the minor planets has arisen. I do not, however, believe that the transit of Venus can be expected to give the distance accurately to one-thousandth part. It is impossible to define the contacts with the precision that would be required. It was on the first night of the present century, a date very easy to remember, that the first of the minor planets was discovered; a few others were quickly added, and 40 years later the career of discovery was reopened. Fresh planets were added by units, by tens, and by scores, until at the present moment we recognise about 240 of these objects revolving around the sun in the gap between Mars and Jupiter. The sun, which controls the mighty planets of our system, does not disdain to guide with equal care the tiny globes which form the minor planets. Each revolves in an elliptic orbit, and at certain times some of them approach near enough to the earth to have their distances measured. The observations can be made with very great precision; they can be multiplied to any extent that may be desired. They can be discussed with geometrical accuracy, so that from them one result and only one can be deduced. In speaking of these planets as small objects, I must be understood to use the word in a comparative sense. They are small as planets, but perhaps the area of an average one might be comparable with that of a good-sized English county. The discoveries of minor planets have added enormously to the labours of those astronomers who compute the movements of the solar system. The task of predicting the places of the minor planets has been for many years most ably accomplished in the Berlin "Ephemeris." The editor must be sometimes alarmed at the daily extension of his list. Many of these bodies are of but little interest. Perhaps it would be no great harm to allow a good many of them to get lost again, and be no more followed by telescopes or computers. Some of these little bodies have, however, a great astronomical future. They seem destined to tell us more faithfully than Venus or than Mars what is really the distance from the earth to the sun. The very small ones will not answer; they can only be seen in very powerful telescopes, and they do not admit of being measured with the necessary accuracy. It is also obvious that the planets to be chosen must be as near to the earth as possible. They should have orbits possessing a high degree of eccentricity, so that when in perihelion and in opposition simultaneously the approach may be made as close as possible. Under favourable circumstances a minor planet will approach the earth to a distance but little more than three-quarters of the distance of the sun. These various conditions limit the number of minor planets available for this purpose to about a dozen, of which one or two will usually be suitable each year. About two years ago Mr. Gill invited astronomers in the northern hemisphere to co-operate with him in the southern in an attempt to apply this method to Victoria and to Sappho. It became my duty to co-operate in this scheme, so far as my opportunities went. As the planet pursues its course through the sky, and as the sky is everywhere studded over with countless myriads of minute stars, it is evident that the planet itself so like a star will always have some stars in its immediate neighbourhood. As the movements of the planet are well known, it is possible to foretell where it will be on each night that it is to be observed. The scheme was completely drawn up many months before the observations were to commence. Each observer who participated in the work was thus advised beforehand of the stars which were to be employed each night. Viewed from any part of the earth, from the Cape of Good Hope or from Great Britain, the positions of the stars are absolutely unchanged. Their distance is so stupendous that a change of place on the earth displaces them to no appreciable extent. But the case is different with Victoria. It is hardly one-millionth part of the distance of the stars, and thus the displacement of the planet when viewed from the Cape and when viewed from Europe is measurable. The measurements are made from a comparison star with a micrometer or a heliometer. The star is one beautifully-defined point, the planet is another, and the difference of declination between the two can be measured with a high degree of accuracy. Two comparison stars symmetrically placed with regard to the planet are usually employed, as a number of sources of error can be thus eliminated. The displacement of the planet is to be elicited by comparison between the observations in the northern hemisphere with those in the southern hemisphere. The observations must be made as nearly as possible at the same time, due allowance being made for the motion of the planet in the interval. Although every precaution is taken, yet the fact remains that we are obliged to compare the measures made by observers in the northern hemisphere with those made by different observers, and, of course, different instruments in the southern hemisphere. In this respect we are, no doubt, at no greater disadvantage than in the transit of Venus; yet is is possible to obviate even this difficulty, and thus to give the minor planet method a great advantage over its rival. The difficulty would be overcome if we could conceive that an observer and his observatory, after making a set of observations on a fine night in one hemisphere, were to be transferred, instruments and all, to the other hemisphere, and there to repeat the observations. This problem can be solved without any miraculous agency, and in it we have undoubtedly the most perfect mode of measuring the sun's distance with which we are acquainted. This method has already been carried out with success by Mr. Gill in the case of Juno, but there are other planets more favourably situated, and the work can be done for a mere fraction of the expense of the much more cumbrous transit of Venus. Take, for instance, one of the little planets which sometimes approach to within 70,000,000 miles from the earth. When the opposition is drawing near, a skilled observer is to be placed on some suitable station near the equator. The instrument he is to use should be the heliometer. It can be used to measure stars at a greater range than is attainable with the filar micrometer. The measurements are to be made in the evening as soon as the planet has risen high enough to enable it to be seen distinctly. The observer and the observatory are then to be transferred to the other side of the earth. How is this to be done? Say, rather, how you could prevent it being done? Is not the earth rotating around its axis, so that in the course of a few hours the observatory on the equator is carried bodily round for thousands of miles? Before the morning dawns the observations are to be repeated. The planet is found to have changed its place very considerably with regard to the stars. This is partly due to its own motion, but it is also largely due to the parallactic displacement arising from the rotation of the earth, which may amount to as much as 20 seconds. The measures on a single night with the heliometer should not have a mean error greater than one-fifth of a second, and we might reasonably expect that observations could be secured on about 25 nights during the opposition. Four such groups would give the sun's distance to one-thousandth part. The chief difficulty of the process arises from the motion of the planet during the interval which divides the evening from the morning observations. This, it must be admitted, is a drawback to the method. It can, however, be avoided by diligent and and repeated measurements of the place of the planet with respect to the stars among which it passes. Let us hope that long before another transit of Venus shall come round the problem will have been satisfactorily solved by the minor planets. It will surely be expected that I shall not close this lecture without an attempt to say what the distance of the sun is so far as modern research has gone. Reviewing all the different methods, the most probable value seems to be 92,700,000 miles. It does not seem likely that this can be erroneous to the extent of 300,000 miles.

GALVANI AND ANIMAL ELECTRICITY.

THE Monday evening discourse during the meeting of the British Association was delivered by Prof. McKendrick, F.R.S., who said:—

In these days, when electricity is commanding universal attention as a great force capable of being made subservient to humanity, it may be appropriate to consider some of the phenomena of electricity produced by living tissues and by living organs, or what is called animal electricity. Most of the modern developments of electrical science trace their origin to the physiological experiments of Galvani, the Professor of Anatomy at Bologna in 1786. In the critical inquiry made by Volta into the question started by Galvani, he was led to the invention of the Voltaic pile, which not only for a time threw into neglect the question of animal electricity, but also was the starting point of the electrical science of the present day. In 1820 Oersted made the discovery of electro-magnetism. This led to the invention of the astatic needle (Ampère), and of the multiplier or galvanometer (Schweigger); and in 1827 Nobili constructed a galvanometer of great sensibility, by which he could reinvestigate the question of whether or not currents of electricity could be obtained from animal tissues. He found that such currents did exist, and he supposed they were due to thermo-electric action. About 10 years thereafter (1837) Matteucci, of Pisa, again investigated the matter, and found that currents could be obtained from animal structures, even where all suspicion of thermo-electric or chemical action was removed. He also discovered that the interior of muscles was negative to their surface, and that it was possible to make a kind of battery of the thighs of newly-killed frogs, which could produce chemical effects similar to those caused by Voltaic elements. Then came the labours of Du Bois Reymond, the present Professor of Physiology in the University of Berlin, which will always mark the commencement of an epoch in the history of animal electricity. Recognising that the detection of the feeble currents from animal structures depended on the delicacy and accuracy of the apparatus employed, he made many improvements in the construction of galvanometers, and in the arrangements for leading off the currents from living textures into the galvanometer. Such galvanometers must be exquisitely sensitive, and it is evident that just in proportion as they are so, so will be the difficulty of making an arrangement which will lead off any current that may exist, say in living muscles, without causing a current itself. If we apply to a bit of muscle the ends of the copper wires coming from a delicate galvanometer we either get no effect or an effect due to the action of the muscle substance, or the fluid covering it, on the copper wire. We must have some arrangement, which, while touching the muscle, will not cause any chemical change in it, and at the same time will draw off into the galvanometer circuit any current that may come from the muscle itself. That is, the electrodes of the galvanometer must be non-polarisable, even when touching muscle. Du Bois Reymond found that little troughs of zinc, filled with a saturated solution of sulphate of zinc, fulfilled these requirements. Into these are placed bits of blotting-paper, also wet with sulphate of zinc solution, and on the bits of blotting-paper are placed morsels of clay moistened with saliva. When the bits of clay are put into contact so as to make a circuit, no current passes through the galvanometer. If we now take a muscle from the back of the leg of a frog, cut it across, and place it on the clay pads so that the section of the muscle touches one pad and the surface of the muscle the other, a current of electricity passes through the galvanometer, as shown by the swing of the needle. This was shown by the lecturer, a beam from a limelight being reflected on a screen by a mirror attached to the needles of the galvanometer. It was then shown that an uninjured frog's muscle gives no current; that no current can be got from two uninjured surfaces nor from two transverse sections; but only, speaking generally, when one clay pad touches a section and when the other touches a surface. This may be called muscle-current. A similar current, though much weaker, can be obtained from living nerve. It was also shown that when a muscle is caused to contract, as it does naturally, the so-called muscle-current is diminished; at all events, suppose the current from a muscle brings the needle of the galvanometer to a certain point, if the muscle then be caused to contract, the needle will swing back to nearly its zero point. This reverse—the so-called negative variation—indicates that an electrical change in the muscle happens when it contracts. But by refined methods of experiment it has been shown that this change really occurs before the muscle contracts—that is, the change in the electrical state of the muscle is an expression of the chemical changes occurring in it, which are antecedent to the muscular movement. Much discussion has taken place as to what these currents really mean; but the majority of physiologists agree with Hermann, of Zurich, in thinking that the current obtained on cutting or injuring the muscle or nerve is really due to the dying of the muscle or nerve substance at the point of section, and that the so-called "negative variation" is the current indicating functional activity. That is, living substance dies at the plane of section, and in dying it acquires a lower potential than the living matter, thus giving rise to a current. Again suppose a living muscle giving no current, on stimulating it, by irritating its nerve, so as to cause the muscle to contract, a lower potential is produced at the points in the muscle where the nerve fibres end, and there is thus a negative variation. Further, it has been shown that this negative variation passes like a wave through the muscle substance, and that the wave has disappeared before the muscle contracts. If, then, electrical changes occur during the activity of muscle and nerve, it is natural that physiologists might expect to detect changes in the beating heart. This is the case. It was shown, by projecting its image on a screen that the uninjured frog's heart, isolated from the body, still lives, and while beating, gave with each beat an electrical variation, as shown by the swing of the galvanometer needle. The uninjured heart gives no current, but when slightly injured there is a variation in its electrical state with each beat. Then the lecturer showed that light causes an electrical change in the eye. Placing the eye of a frog in the galvanometer cushions, it was shown that there was a current passing from the cornea to the back of the eye. In the dark little or no change could be seen except what might be due to the drying of the living structures forming the eye; on allowing light to fall on the eye, there was at once an increase in the current. This continued for a time, then began to fall off, and, on light being removed, there was another increase, and then a sudden and rapid fall off. This action, first shown by Prof. Holmgren, Prof. Dewar, and the lecturer, showed a specific influence of light on the retina. It could not be called a negative variation. It indicated chemical changes occurring in the retina. Lastly, the lecturer showed the production of currents from the living man. Placing the hands in two vulcanite troughs, communicating by platinum plates with the galvanometer and filled with a weak solution of salt, he showed that on contracting one arm, a deflection of the galvanometer needle was produced. When both arms were quiet there was no current: on contracting one arm a current was at once produced. This current, the lecturer was inclined to think, was due to action of the fluid on the skin, and not to currents from the muscles, and that the differences were due to differences of contact. In summing up, after a few remarks regarding electric fishes, the lecturer said that all of these electrical changes were really expressions of the vital changes occurring in living tissues under the action of stimuli. It was no part of the functions of nerves, muscles, or of the retina of the eye to produce currents under the action of their relative stimuli; but such currents indicated chemical changes in the organs or tissues. For example, the contraction of a muscle is a movement following or consequent upon many chemical changes, among the results of which were the production of heat and differences of electrical potential. Thus there was no special production of electricity, except in the case of electrical fishes and possibly of some other animals. In most animals, including man, the production of currents was an incidental phenomenon, indicating chemical operations and nothing more. Besides, the currents so produced were feeble and evanescent, and bore no relation to the general well-being. Consequently all attempts to influence the living body by magnets had no rational basis. Prof. McKendrick said he had tested this question by powerful electro-magnets, and had not been able to detect that they had the slightest influence on any vital phenomena. It need hardly be added that the so-called phenomena of animal magnetism are of an entirely different kind from those discussed. These are of a subjective character, dependent on peculiar states of the nervous system, having nothing whatever to do with electricity or magnetism; but still in a sense they are phenomena as real as those of physical science. Their subjective character, however, renders them specially difficult of investigation, and consequently they are more liable to fall into the hands of the charlatan. One safeguard against this is the recognition of what the electrical phenomena of the living body really mean, and one purpose of this lecture will be served if it shows that to detect and account for these phenomena requires the most refined methods of the physicist and of the physiologist, and that they give us only a glimpse into the intricate changes occurring in living tissue.

The New Bankruptcy Law.—Mr. F. Wetherfield, of 2, Gresham-buildings, Guildhall, has issued a handy and comprehensive guide to the new Law of Bankruptcy, which will be of considerable use to all traders. Speaking broadly of the new Act, Mr. Wetherfield thinks it will be more expensive in its actual working than any former statute. But if it really saves creditors being defrauded by their debtors and prevents trustees from making away with the funds, this costliness will repay itself. There is every reason to believe that debtors, at all events, will be more sharply looked after than they have ever been before, and that a tight hand will be held upon their estates, while creditors, even, and certainly their trustees, will be under the same sort of strict supervision. Mr. John Rae, LL.D., F.S.A., has also issued a similar treatise, which is published by Messrs. Marlborough and Co., of 51, Old Bailey. Mr. Rae says:—"Altogether the Act exhibits boldness, comprehensiveness, and strength. Wrought by an infinity of labour, guided throughout by an inflexible purpose of reform, experience will test its efficiency and grandeur: time must reveal and record the verdict upon its wisdom and consolidation."

M. Antony Guyard has devised a photometer of considerable delicacy, dependent on the decomposition of iodide of nitrogen placed in aqueous ammonia, which is proportional to the intensity of light. The volume of nitrogen evolved in a given time is a measure of the amount of luminous radiation.

BRITISH ASSOCIATION.

THE ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by Prof. Olaus Henrici, F.R.S., the president, and was devoted mainly to a discourse on that branch of mathematics which has held most attraction for Prof. Henrici--viz., pure geometry as apart from algebra. The following is an abstract of the address:—Pure geometry seems to me to be of the greatest educational value, and almost indispensable in many applications; but it has scarcely ever been introduced at Cambridge, the centre of mathematics and mathematical education in England. The number of geometrical methods now in use is astonishingly great. These differ, on the one hand, according to the nature of the result aimed at, but, on the other, according to the amount of algebra employed, and to the relation in which this algebra stands to the pure "*Anschauung*" (intuition by inspection). It is the inspection of figures which is of the greatest importance in geometry. It is hereby of little consequence whether the figures are seen by the physical eye or only mentally; because the conception of that space in which we perceive everything and without which we can perceive nothing, which therefore is, according to Kant, a form of our *Anschauung*, is built up in our mind through many generations in conformity with sensual impressions.

In some of the methods just referred to no algebra is used at all, whilst others may be distinguished according to the nature of the algebra used, whether equations containing one, two, three, or more variables are employed. In such a division, Von Staudt's system, without a vestige of algebra, would occupy the one end, and the purely algebraical theory of invariants with geometrical interpretation the other. There is, however, not only a difference in the amount of algebra used, but, if possible, a greater one in the manner in which the symbols are interpreted. And it is here that algebra has apparently the greater power. One algebraical theorem, by being read in different ways, by giving ever different meanings to the symbols, reveals a variety of geometrical and other theorems. We have in it the crystallised form, the very essence of the mathematical truth, but in the most abstract form conceivable. Now this most abstract form is the highest and the most perfect which mathematical truth as such can assume, and which it must assume before a theory is really complete in the eyes of a pure mathematician. It is only in this shape that it is ready to be turned to account in any direction where it may be needed.

In thus placing algebra on the highest pinnacle, the reasons will be apparent which will make many mathematicians, not to mention others, prefer the truths it reveals cast in a mould which connects them with concrete things rather than with abstract notions. In fact, to be thoroughly at home in the highest theories of pure algebra requires some of the genius of men like Cayley and Sylvester who have founded, and to a great extent built up, modern algebra. But even they constantly make use of geometry to assist them in their investigations, and no one could have expressed this more strongly than Prof. Sylvester himself in his brilliant address delivered from this chair at the Exeter meeting of our Association.

If this is so, surely every progress in the spread of the knowledge of pure geometry should be welcomed and encouraged; but in England pure geometry is almost unknown excepting in the elements as contained in Euclid and in the old-fashioned geometrical conics. The modern methods of synthetic projective geometry as developed on the Continent have never become generally known here.

The best analytical methods of the Continent were introduced into England, rapidly assimilated and made the foundation of new theories, so that the mathematical activity in this country is now at least as great as it ever has been anywhere.

But whilst analysis, algebra, and with it analytical geometry, made rapid progress, pure geometry was not equally fortunate. Here the hold which Euclid had long obtained, strengthened, no doubt, by Newton's example, prevented any change in the methods of teaching.

Most of all, perhaps, solid geometry has suffered, because Euclid's treatment of it is scanty, and it seems almost incredible that a great part of it—the mensuration of areas of simple curved surfaces and of volumes of simple solids—is not included in ordinary school teaching. The subject is, possibly, mentioned in arithmetic, where, under the name of mensuration, a number of rules are given. But the justification of these rules is not supplied, except to the student who reaches the application of the integral calculus; and what is almost worse is that the general relations of points, lines, and planes, in space, is scarcely touched upon, instead of being fully impressed on the student's mind.

Pure geometry has become a most important instrument for research, rivalling in power the more or less algebraical methods, and surpassing them

[illegible]

THE ADDRESS IN CHEMISTRY.

The address in Section B was delivered by the president, Prof. J. H. Gladstone, F.R.S., who, in the course of his remarks, said:—Though theoretical and practical chemistry are now intertwined, with greatest advantage to each, they appear to have been far apart in their origin. Practical chemistry arose from the arts of life, the knowledge empirically and laboriously acquired by the miner and metallurgist, the potter and the glassworker, the cook and the perfumer. Theoretical chemistry derived its origin from cosmogony. In the childhood of the human race the question was eagerly asked, "By what process were all things made?" and some of the answers given started the doctrine of elements. The earliest documentary evidence of this is probably contained in the Shu King, the most venerated of the Chinese classics for its antiquity. It is an historical work, and comprises a fragment of still more venerable age, called "The [illegible], with its Nine Divisions," which purports to have been given by Heaven to the [illegible] to teach him his royal duty and "the proper virtues of the various relations."

Dr. Gladstone proceeded to give an interesting resumé of the history of elements as understood by the Chinese, the Indian races, the Greeks, and the Arabs, and having brought it down to modern times he proceeded:—

In this ever-growing list of elements not one has been resolved into simpler bodies for three-quarters of a century; and we, who are removed by two or three generations from the great builders of our science, are tempted to look upon these bodies as though they were really simple forms of matter, and not only unresolved, but unresolvable. The notation we employ favours this view and stamps it upon our minds. Is it, however, a fact that these reputed elements are really simple bodies, or, indeed, are they widely different in the nature of their constitution from those bodies which we know to be chemical compounds? Thus, to take a particular instance, are fluorine, chlorine, bromine, and iodine essentially distinct in their nature from the compound halogens, cyanogen, sulphocyanogen, [illegible], &c.? Are the metals lithium, sodium, and potassium essentially distinct from such alkaline bases as ammonium, ethylamine, di-ethylamine, &c.? No philosophical chemist would probably venture to answer this question categorically with either "yes" or "no."

It was at first hoped that the spectroscope might throw much light upon the nature of elements, and might reveal a common constituent in two or more of them. Thus, for instance, it was conceivable that the spectrum line of bromine or iodine vapour might consist of the rays given by chlorine *plus* some others. All expectations of this have hitherto been disappointed; yet, on the other hand, it must not be supposed that such a result disproves the compound nature of elements, for as investigation proceeds it becomes more and more clear that the spectrum of a compound is not made up of the spectra of its component parts. Again the multiplicity of rays given out by some elements, when heated in a gaseous condition, such as iron, has been supposed to indicate a more complex constitution than in the case of those metals, such as magnesium, which give a more simple spectrum. Yet it is perfectly conceivable that this may be due to a complexity of arrangement of atoms all of the same kind. Again, we have changes of a spectrum at different temperatures: new rays appear, others disappear; or even there occurs the very remarkable change from a fluted spectrum to one of sharp lines at irregular intervals, or to certain recurring groups of lines. This, in all probability, does arise from some redistribution, but it may be a redistribution in a molecular grouping of atoms of the same kind, and not a dissociation or rearrangement of dissimilar atoms.

A stronger argument has been derived from the revelations of the spectroscope in regard to the luminous atmospheres of the sun. There we can watch the effect of heat enormously transcending that of our hottest furnaces, and of movements compared with which our hurricanes and whirlwinds are the gentlest of zephyrs.

At the meeting of this Association at Ipswich, in 1851, M. Dumas showed that in several cases analogous elements form groups of three, the middle one of which has an atomic weight intermediate between those of the first and third, and that many of its physical and chemical properties are intermediate also. During the discussion upon his paper, and subsequently, attention was drawn to the fact that this is not confined to groups of three, but that there exist many series of analogous elements having atomic weights which differ by certain increments, and that these increments are in most cases multiples of 8. Thus we have lithium, 7; sodium, 23, *i.e.* 7 + 16; potassium, 39, *i.e.* 7 + (16 × 2); and the more recently discovered rubidium, 85, *i.e.* 7 + (16 × 5) nearly; and cæsium, 133, *i.e.* 7 + (16 × 8) nearly. This is closely analogous to what we find in organic chemistry, where there are series of analogous bodies playing the part of metals, such as hydrogen, methyl, ethyl, &c., differing by an increment which has the atomic weight 14, and which we know to be CH_2. Again, there are elements with atomic weights nearly the same or nearly multiples of one another, instances of which are to be found in the great platinum group and the great cerium group. This suggests the analogy of isomeric and polymeric bodies. There is also this remarkable circumstance; the various members of such a group as either of those just mentioned are found together at certain spots on the surface of the globe, and scarcely anywhere else.

The specific refraction has been determined for a large majority of the elements, and is a very fundamental property, which belongs to them apparently in all their combinations, so long at least as the atomicity is unchanged. If the figures representing this property be inserted into Mendelejeff's table, we find that in the vertical columns the figures almost invariably decrease as the atomic weights increase. If, however, we look along the horizontal columns, or better still if we plot the figures in the table by which Lothair Meyer has shown graphically that the molecular volume is a periodic function of the atomic weights, we shall see that they arrange themselves in a series of curves similar to but not at all coincident with his. The observations are not so complete or accurate as those of the molecular volumes, but they seem sufficient to establish the fact, while the points of the curves would appear to be, not the alkaline metals, as in Meyer's diagram, but hydrogen, phosphorus and sulphur, titanium and vanadium, selenium, antimony. Now, if we were to insert the specific refractions of cyanogen, ammonium, and methyl into this table, we should again show that it was an intrusion of strangers not in harmony with the family of elements.

But there is another argument to be derived from the action of light. The refraction equivalent of a compound body is the sum of the refraction equivalents of its compounds; and, if there is anything known for certain in the whole subject, it is that the refraction equivalent of an organic compound advances by the same quantity (7·6) for every increment of CH_2. If, therefore, the increment between the different members of a group of analogous elements, such as the alkaline metals, be of the same character, we may expect to find that there is a regular increase of the refraction equivalent for each addition of 16. But this is utterly at variance with fact; thus, in the instance above quoted, the refraction equivalent of lithium being 3·8, that of sodium is 4·8, of potassium 8·1, of rubidium 14·0, and of cæsium about 13·7.

The general tendency of these arguments is evidently to show that the elementary radicals are essentially different from the compound radicals, though their chemical functions are similar.

There remains still the hypothesis that there is a "primordial element," from which the others are derived by transmutation. With the sages of Asia it was the "blue ether," with Thales water, with Dr. Prout hydrogen. The earlier views have passed away, and the claims of hydrogen are being fought out on the battle-field of atomic weights and their rigorous determination.

There does not appear to be any argument which is fatal to the idea that two or more of our supposed elements may differ from one another rather in form than in substance, or even that the whole seventy are only modifications of a prime element; but chemical analogies seem wanting. The closest analogy would be if we could prepare two allotropic conditions of some body such as phosphorus or cyanogen, which should carry their allotropism into all their respective compounds, no compound of the one form being capable of change into a compound of the other. Our present knowledge of allotropism and of variations in atomicity, affords little, if any, promise of this.

The remarkable relations between the atomic weights of the elements, and many peculiarities of their grouping, force upon us the conviction that they are not separate bodies created without reference to one another, but that they have been fashioned or built up from one another according to some general plan. This plan we may hope gradually to understand better, but if we are ever to transform one of these supposed elements into another, or to split up one of them into two or three dissimilar forms of matter, it will probably be by the application of some method of analysis hitherto unknown.

THE ADDRESS IN GEOLOGY.

The address in Section C was delivered by Prof. W. C. Williamson, F.R.S., the president, who gave an interesting and almost elaborate sketch of the present state of our knowledge of the vegetation of the Carboniferous Age. After pointing out that while German and English palæontologists are in substantial agreement, French savants take different views of what is to be learned from the fossil plants, Prof. Williamson proceeded to say:—The common state in which our fossil plants are preserved presents a source of error that is positive as well as negative. Most of those from our coal measures consist of inorganic shale, sandstone, or ironstone, invested by a very thin layer of structureless coal. The surface of the inorganic substance is moulded into some special form dependent upon structural peculiarities of the living plants, which structures were sometimes external, sometimes internal, and sometimes intermediate ones. Upon this inorganic cast we find the thin film of structureless coal, which, though of organic origin, is practically as inorganic as the clay or sandstone which it invests; but its surface displays specific sculpturings which are apt to be regarded as always representing the outermost surface of the plant when living, whereas this is not always the case. That the coaly film is a relic of the carbonaceous substance of the living plant is unquestionable; but the thinnest of these films are often the sole remaining representatives of structures that must originally have been many inches, and in some instances even many feet, in thickness. In such cases most of the organic material has been dissipitated, and what little remains has often been consolidated in such a way that it is merely moulded upon the sculptured inorganic substance which it covers, and hence affords no information respecting the exterior of the fossil when a living organism. It is, in my opinion, from specimens like these that the smooth bark of the Calamite has been credited with a fluted surface, and the Trigonocarpons with a merely triangular exterior and a misleading name, as it long caused the inorganic casts known as Sternbergiæ to be deemed a strange form of plant that had no representative amongst living types. In other cases the outermost surface of the bark is brought into close contact with the surface of the vascular cylinder. I have a Stigmaria in which the bases of the rootless appear to be planted directly upon that cylinder, the whole of the thick intermediate bark having disappeared. In other examples that vascular zone has also gone. Thus the innermost and outermost surfaces of a cylinder, originally many inches apart, are, through the disappearance of the intermediate structures, brought into close approximation. In such cases, leaves and other external appendages appear to spring directly from what is merely an inorganic cast of the interior of the pith. I believe that many of our Calamites are in this condition. Such examples have suggested the erroneous idea that the characteristic longitudinal flutings belong to the exterior of the bark.

Entering upon a more detailed review of our knowledge of the Carboniferous plants, and commencing at the bottom of the scale, we come to the lowly group of the Fungi, which are unquestionably represented by the *Peronosporites antiquarius* of Worthington Smith. There seems little reason for doubting that this is one of the Phycomycetous Fungi, possibly somewhat allied to the *Saprolegnieæ*; but since we have as yet no evidence respecting its fructification, these closer relationships must, for the present, remain undetermined.

That marine plants of some kind must have existed simultaneously with the molluscous and other plant-eating animals of Palæozoic times is obviously indisputable. But what those plants were is another question. The widest differences of opinion exist in reference to many of them. A considerable number of those recognised by Schimper, Saporta, and other palæobotanists, are declared by Nathorst to be merely inorganic tracks of marine animals - and in the case of many of these I have little doubt that the Swedish geologist is right. Others have been shown to be imperfectly preserved fragments of plants of much higher organisation than Algæ, branches of Conifers even being included amongst them. I have as yet seen none of Carboniferous age that could be indisputably identified with the family of Algæ, though there are many that look like, and may probably be, such. The microscope alone can setttle this question, though even this instrument fails to secure unity of opinion in the case of Dawson's *Prototaxites*, and no other of the supposed seaweeds hitherto discovered have been sufficiently well preserved to bear the microscopic test; hence I think that their existence in Carboniferous rocks can only be regarded as an unproved probability. Mere superficial resemblances do not satisfy the severe demands of modern science, and probabilities are an insufficient foundation upon which to build evolutionary theories. Seeing what extremely delicate cell-structures *are* preserved in the Carboniferous beds, it cannot appear other than strange that the few imperfect Fungoid relics just referred to constitute the only terrestrial cellular Cryptogams that have been discovered in the Carboniferous strata. The Darwinian doctrine would suggest that these lower forms of plant life ought to have abounded in that primæval age; and that they were capable of being preserved is proved by the numerous specimens met with in Tertiary deposits. Why we do not find such in the Palæozoic beds is still an unsolved problem. The Vascular Cryptogams, next to be considered, burst upon us almost suddenly and in rich profusion during the Devonian age; they are equally silent in the Devonian and Carboniferous strata as to their ancestral descent.

The older taxonomic literature of Palæozoic Fern-life is, with few exceptions, of little scientific value. Hooker and others have uttered in vain wise protests against the system that has been pursued. Small fragments have had generic and specific names assigned to them, with supreme indifference to the study of morphological variability amongst living types. At present the study of fossil ferns is affording some promise of a newer and healthier condition. We are slowly learning a little about the fructification of some species, and the internal organisation of others. Facts of these kinds, cautiously interpreted, are surer guides than mere external contours; unfortunately, such facts are, as yet, but few in number, and when we have them we are too often unable to identify our detached sporangia, stems, and petioles with the fronds of the plants to which they primarily belonged.

That all the Carboniferous plants included in the genera *Pecopteris*, *Neuropteris*, and *Sphenopteris* are ferns appears to be most probable: but what the true affinities of the objects included in these ill-defined genera may be is very doubtful. Here and there we obtain glimpses of a more definite kind.

That the coal-measures contain the remains of arborescent ferns has long been known, especially from their abundance at Autun. In Lancashire I have only met with the stems or petioles of one species preserving their internal organisation. The Rev. H. H. Higgins obtained stems that appear to have been tree-ferns from Ravenhead, in Lancashire, and it is probable that most of the plants included in the genera *Psaronius*, *Caulopteris*, and *Protopteris*, are also tree-ferns.

Nearly all the Calamitean fossils found in shales and sandstones consist of an inorganic, superficially fluted substance, coated over with a thin film of structureless coal (see "Histoire des Végétaux Fossiles," Vol. I., pl. 22), *the latter being exactly moulded upon and following the outlines of the inorganic fluted cast that underlies it.* Brongniart and those who adopt his views believe that the external surface of this coal-film exactly represents the corresponding external surface of the original plant. Hence the conclusion was arrived at that the plant had a very large central fistular cavity surrounded by a very thin layer of cellular and vascular tissues as in some living Equisetums. On the other hand, Brongniart also obtained some specimens of what he primarily believed to be Calamites, in which the central pith was surrounded by a thick layer of woody tissue arranged in radiating laminated wedges, separated by medullary rays. The oxygenous structure of this woody zone was too obvious to escape his practised eye. But, not supposing it possible that any Cryptogam could possess a cambium-layer and an exogenous mode of development, Brongniart came to the conclusion that the thin-walled specimens found in the shales and sandstones were true *Equisetaceæ*, those with the thick woody cylinders being exogens of another type. His conclusion that they were Gymnosperms was a purely hypothetical one, justified by no one feature of their organisation.

My researches, based upon a vast number of specimens of all sizes, from minute twigs little more than the thirtieth of an inch in diameter, to thick stems at least thirteen inches across, led me to the conclusion that we have but one type of Calamite; and that the differenes which misled Brongniart are merely due to variations in the mode of their preservation. It became clear to me that the outer surface of the coaly film in the specimens preserved in the shales and sandstones did *not* represent the outer surface of the living plant, but was only a fractional remnant of the carbon of that plant which had undergone a complete metamorphosis; the greater part of what originally existed had disappeared, probably in a gaseous state, and the little that remained, displaying no organic structure, *had been moulded upon the underlying inorganic cast of the medullary cavity.* This cast is always fluted longitudinally and constructed transversely at intervals of varying lengths. Both these features were due to impressions made by the organism upon the inorganic sand or mud filling the medullary cavity whilst it was in a plastic state, and which subsequently became more or less hardened; the longitudinal grooves being caused by the pressure of the inner angles of the numerous longitudinally vascular wedges, and the transverse ones partly by the remains of a cellular nodal diaphragm, which crossed the fistular medullary cavity, and partly by a centripetal encroachment of the vascular zone at each of the same points. My cabinets contain an enormous number of sections of these plants in which the minutest details of their organisation are exquisitely preserved. These specimens, as already observed, show their structure in every stage of their growth, from the smallest twigs to stems more than a foot in diameter. Yet these various examples are all, without a solitary exception, constructed upon one common plan.

At the meeting of the British Association at Liverpool in 1870, I first announced that a thick, secondary, exogenous growth of vascular tissue existed in the stems of many Carboniferous cryptogamic plants, especially in the Calamitean and Lepidodendroid forms. But, at that time, the ideas of M. Brongniart were so entirely in the ascendent, that my notions were rejected by every botanist present. Though the illustrious French palæontologist knew that such growths existed in *Sigillariæ* and in what he designated *Calamodendra*, he concluded that, *de facto*, such plants could not be Cryptogams. Time, however, works wonders. Evidence has gradually accumulated proving that —with the conspicuous exception of the ferns—nearly every Carboniferous Cryptogam was capable of developing such zones of secondary growth. The exceptional position of the ferns still appears to be as true as it was when I first proclaimed their exceptional character at Liverpool. After thirteen years of persevering domonstration, these views, at first so strongly opposed, have found almost universal acceptance. Nevertheless, there still remain some few who believe them to be erroneous ones.

After referring at some length to the botanical relations subsisting between other plants, pointing out that great progress has been made in our knowledge of Gymnosperms, that Cycads predom

[illegible]

[illegible] Theory of Disease.

[illegible] by the pathologists. [illegible] view they should expect [illegible] of always developing themselves in [illegible] mode, and giving rise by their introduction into the human body to one fixed and [illegible] type of morbid action, these different forms [illegible] bacteria, or micrococci, which they were [illegible] to regard as the germ of the different [illegible] disease recognised by the [illegible] should be capable of undergoing con[illegible] according to the conditions [illegible] developed, especially when [illegible] through a suc[illegible]. And they should further [illegible] disease which they now regarded [illegible] by a process [illegible] the well-marked [illegible] present, they [illegible] times graduate [illegible] disease germ. [illegible] one, or, con[illegible] type of disease showing [illegible] mitigated form. [illegible] the culture [illegible] Pasteur and his followers had proved [illegible] certain disease-germs [illegible] of special research. [illegible] capable of a [illegible] [illegible] power of the [illegible]. And there was, in [illegible] very strong grounds for [illegible] innocent hay-bacillus, [illegible] milk, simply caused [illegible] power of developing [illegible] might undergo such an [illegible] become the germ of [illegible] [illegible]ding, therefore, the [illegible] pathologists to regard the [illegible] disease as specifically [illegible] inexact observation [illegible] counter to their pre[illegible] that the application of [illegible] the study of these [illegible] belief that the same [illegible] under different con[illegible] themselves under a variety [illegible] larger study of the [illegible] the belief that, whilst [illegible] in the human [illegible] fixity, yet that [illegible] over the [illegible] and that there [illegible] the various [illegible] which breed in [illegible] over which [illegible] various [illegible] exerted [illegible]. He held [illegible] all the [illegible] on the [illegible] accurate [illegible] followed by [illegible].

AN [illegible] AND [illegible]

A [illegible] a brilliant [illegible] has been [illegible]-street, [illegible]. There is [illegible] white or [illegible] known as [illegible] soap, and [illegible] sufficient heat [illegible] in about [illegible] of the [illegible] yellow [illegible] sixth of [illegible] is dissolved [illegible] spirits of [illegible] these solvents, [illegible] reduce the [illegible] pasty condition. A [illegible] of beeswax is added to render [illegible] lustre or [illegible]. In order [illegible] citron[illegible], attar of [illegible] is added.

[illegible] ready for use, [illegible] will still re[illegible] it may be applied to [illegible] without requiring [illegible] with other materials. It is [illegible], or imparting [illegible] made of leather; but it may be used with advantage for polishing furniture, and, for this purpose, the vegetable black is omitted from the mixture. It may also be used for imparting a [illegible] appearance to articles made of papier-mâché, or [illegible] other articles or materials.

DR. D. T[illegible] states that if anthracene is dissolved in benzol and exposed to the direct rays of the sun, it becomes turbid and deposits crystals. This [illegible] substance has been named paranthracene. If melted it is reconverted into anthracene.

SCIENTIFIC NEWS.

THE comet, the discovery of which by Prof. Lewis Swift we announced last week, p. 60, is mentioned in the Dun Echt Circular No. 81; but at the date of issue it had not been observed by any one else. The same circular contains observations of comet *b*, 1883, which, it is thought, may possibly be Comet Pons of 1812, made at Leiden, Rome, and Dun Echt. MM. Schulhof et Bossert's elements and ephemeris are given in Circular No. 82, from which we find that the calculated position of Comet Pons-Brooks for Sept. 29 is R.A. 16h. 26m. 40·94s.; N. Dec. 59° 13' 41·0", Berlin midnight. The comet will remain above the horizon for some time, and during the moonless evenings now prevailing, will be within reach of telescopes of moderate power.

The next meeting of the British Association will be held at Montreal, commencing on August 27, 1884, Prof. Lord Rayleigh being the president elect. The American Association meets at Philadelphia on Sept. 3, 1884, and will welcome all visitors belonging to the British Association by placing them on the footing of members. Sir C. Tupper assured the general committee last Monday, that nothing would be wanting on the part of the Canadians to show how highly they appreciated the honour of the visit. The Canadian House of Commons has voted the sum of £4,000 to defray the expenses of receiving the Association, and the steamboat and railway arrangements for making long excursions are on an exceptional scale of liberality. The following names are given as probable vice-presidents:—The Marquis of Lansdowne, the Marquis of Lorne, Sir C. Tupper, the Hon. Sir A. Galt, Sir N. Dorion, Principal Dawson, Dr. W. H. Hingston, Dr. T. Sterry Hunt, Prof. Huxley, Prof. Frankland, Sir W. Siemens, and Sir L. Playfair.

Aberdeen has been chosen as the meeting-place in 1885, the only other town seeking the honour being Bournemouth.

The recent meeting of the American Association was not altogether a success, as the attendance was anything but large,—the distance of Minneapolis from the centres of scientific thought being too great to tempt many to leave their homes.

On Monday, at the British Association, a paper, the production of two authors, was read, in which it was stated that no really practically efficient secondary battery had been produced: and which described a new combination of boiler and coke oven, by which the value of the coke obtained equalled that of the coal used, and so the steam was obtained free of cost!

The death of the distinguished physicist, M. Joseph Antoine Ferdinand Plateau, is announced as having occurred in his eighty-second year. The deceased was Emeritus Professor at Ghent, and was a member of the principal learned societies of Europe.

Mr. Werdermann, the inventor of the well-known semi-incandescent lamp which bears his name, died the other day at the comparatively early age of 55 years. He came to London in 1870 on the breaking out of the war, and brought with him the first Gramme machine introduced into England. He owned, we believe, the English and American patents for that machine, and was a most ingenious inventor of electrical appliances, but lacked the "business" qualities which enabled others to become rich at the expense of shareholders.

Baron Nordenskjold, in the *Sophia*, arrived at Thurso last week, and lost no time in telegraphing that his views as to the interior of Greenland were not supported by the facts. Parties of Laplanders were sent as far as possible into the interior, where they found nothing but snow and ice. "Masses" of fine dust, partly of cosmical origin, occur with the ice. The Laplanders had to proceed on snowshoes, as the snow was too soft for sledges. Baron Nordenskjold says that the glaciers of the east coast are few, and of no great size, and that the fiords are free from ice.

The new Guion liner, *Oregon*, which is to leave Liverpool on her maiden voyage on October 6th, made an average of 20 knots during a long trial last week. The engines indicated more than the estimated 12,000 horse-power. If the *Oregon* can maintain her trial speed of 20 knots across the Atlantic she will about accomplish the westward passage in six days. We gave particulars on p. 404, last volume.

The "Facile" 24-hour road ride, accomplished by Mr. Adams the other day, puts into the shade all similar performances, as he covered 241¼ miles within the time, in spite of the rainy weather and some unavoidable delays while on the road. Deducting the time occupied in taking refreshments and rest, the average speed comes out at more than 11 miles an hour. The machine was a 44in. "Facile."

The "fungus hunt" of the Essex Field Club takes place in Epping Forest next Saturday (to-morrow), and the "cryptogamic meeting" will be held at the "Roebuck," Buckhurst-hill, in the evening, when interesting papers will be read by Dr. M. C. Cooke, F.L.S., Mr. W. G. Smith, F.L.S., and Dr. Wharton, F.L.S.

The *Liverpool Mercury* says that Mr. Banks, of Manchester and Blackpool, has produced a remarkable photograph of the Isle of Man hills, taken from the South Pier, Blackpool, a distance of 60 miles. The original was taken on May 17, the hills being discernible from Blackpool only at sunset in early summer, and was so small that it had to be many times enlarged to reach the carte size.

The Calcutta correspondent of the *Times* states that a remarkable phenomenon has been observed at several places in the Madras and Bombay Presidencies, and has caused much interest, mingled with not a little alarm among the superstitious. For some days the sun presented a distinctly green colour. Several explanations have been put forward, of which the most plausible appears to be that offered by the Government astronomer, that it is due to the passage across Southern India of clouds of sulphurous vapour from the Java volcanoes.

Under the auspices of the Gilchrist Trustees, a course of Penny Science Lectures is about to be given in the Royal Victoria Coffee Hall, Waterloo-road, S.E. The lectures, which are to be illustrated by the oxy-hydrogen light, and in the case of the first two by experiments as well, are to be as follows:—Oct. 2nd and 9th (two lectures), by Mr. W. M. Lant Carpenter, F.C.S., on "Ice, Water, and Steam." Oct. 16th, Mr. P. H. Carpenter, on "Life Under the Ocean Wave." Oct. 23rd, Mr. E. B. Knobel, Sec. R.A.S., on "Comets." Oct. 30th, Mr. C. A. V. Conybeare, on "The Rights and Feelings of an Animal." Nov. 6th, Dr. B. W. Richardson, M.D., LL.D., F.R.S., on "Food and Feeding." If the committee take care to make the lecture the chief feature of the evening, and do not relegate it, as in last year's experiments, to the fag-end of a miscellaneous entertainment, there seems no reason why Penny Science Lectures should not prove as successful and popular in London as they are in the North of England.

Messrs. Macmillan and Co. have made a new departure in English magazine literature with their "English Illustrated Magazine." The printing is excellent, the illustrations perfection, and the price a marvel. The list of contributors to the first number is a list of giants. Mr. F. W. Maitland on the Old and New Law Courts; A. C. Swinburne, Grant Allen on the Dormouse. J. Comyns Carr on Rossetti's Influence on Art; William Black with a story; Professor Huxley on the Oyster; and the first instalment of a novel by Charlotte M. Yonge, together make up a first number which, in literary value, has never probably been approached.

Dyeing Cut Flowers.—It has for a long time been known that the colour of growing flowers can be altered by simply mixing a little dyestuff with the mould in the flowerpot. No one, however, has hitherto thought of changing the colour of flowers when cut. We have in London many artists whose business it is to give to birds finer feathers than Nature has allowed them, and we have now a counterpart in flowers. Mr. Nesbit, a distinguished botanist, has found that by simply soaking the stems of cut flowers in a weak dye solution, their colour can be altered at will, without the perfume or freshness being destroyed. Most beautiful effects are produced by prepared lakes. Singular to say, flowers refuse to absorb certain colours, while they dispose of others in different manners. If placed in a mixed solution they make a complete analysis, and some lilies which had been treated with purple showed distict red and blue veins, the colours having been divided in the process of absorption.—*The Dyer.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE ANTIQUITY OF MAN—STARS VISIBLE IN A 9in. REFLECTOR—APPARATUS FOR OPTICAL EXPERIMENTS—THE OTHER SIDE OF THE MOON—THE INTRODUCTION OF CHRISTIANITY INTO BRITAIN—THE STUDY OF METAPHYSICS.—THE SOLAR CORONA—A PENNY WATER-CLEANER—COMITES TO VEGA—FORMS OF LENSES FOR LEAST ABERRATION.

[21850.]—THE concluding portion of the address of Principal Dawson, which you reproduce on p. 33 *et seq.*, seems to me to lead to one of two conclusions—either that its author is in curious and inexcusable ignorance of the European evidence which shows man to have been pre-glacial upon the earth, or that he is guilty of a deliberate *suppressio veri.* It is simply untrue that "Recently the opinion has been gaining ground that the close of the ice age is very recent" (using the words "very recent" in the sense in which Mr. Dawson obviously intends that they shall be accepted)—at all events, in this country. Just, however, as proverbially any stick will do to beat a dog with, so, in the opinion of an extremely small and insignificant school of geologists, will any argument—or assertion—suffice to show that it was not until "six or seven thousand years ago" that man first appeared upon the face of the earth. The quasi-laudable motive which prompts so gross a misrepresentation of fact is apparent enough; but, as a man who has devoted his whole life and no inconsiderable part of his fortune to the pursuit of science, I must protest against scientific falsehood being advanced to bolster up any theological system whatever. Anyone liable to be misled by Mr. Dawson's specious untruths may with advantage read Sir Charles Lyell's "Antiquity of Man" as a corrective, merely in matters of fact.

Mr. Holmes (letter 21797, p. 37) will find that Browning says (in his "Plea for Reflectors") that reflecting telescopes "in light-grasping powers . . . are equal to an achromatic one-sixth less in diameter." Adopting this formula, a 9in. reflector would have its equivalent in a 7·5in. refractor; the *minimum visibile* of which is the 13·6th magnitude of Argelander. Your correspondent ought to see such objects as the 4th star in β Equulei, or the minute pair between β^1 and β^2 Capricorni easily enough, even in London, on a fine night.

"Physis" (query 51658, p. 46) cannot do better than procure the little book on "Light," by Mayer and Barnard, in the "Nature" series. It contains illustrated descriptions of the most simple apparatus for exhibiting the reflection, refraction, and decomposition of light, so very plainly worded that its perusal would supply your querist with exactly the information he requires.

"The discovery" (if such it be) that the centre of gravity and the centre of figure of the Moon were not coincident, to which "W. G. C." refers in query 51684, p. 46, was first published by Hansen, of Gotha, in the year 1856 (R. A. S. *Memoirs*, Vol. XXIV., p. 31.) Taking the distance from the earth to the centre of figure as 1, he deduced the distance to the centre of gravity as 1·000154. In an editorial footnote on p. 276 of the second volume of the English edition of Arago's "Popular Astronomy" it is astonishingly stated that Hansen found that certain irregularities in the Moon's motion "would be almost wholly accounted for by supposing the centre of gravity to be situated at a distance of 1,740 miles (!) *beyond* the centre of figure," which, remembering that the Lunar radius is only 1081·53 miles, would place her c.g. outside of her altogether by some 660 miles!!! What Hansen really di contend for was that the Moon's centre of gravit was 33 miles farther from us than the centre of h longest diameter, and that this humped figure necessary to explain the irregularities spoken

[illegible]

Herbert [illegible]

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[illegible] branches of

observational astronomy may be organised: so much may be secured by combination, no matter how unskilled the observer may be. Indeed, the council of the society have welcomed the most humble efforts at observation, believing that there are many beginners to whom a little direction and assistance would be of the greatest value. And this is the reason of the marked success of the society, and the cause of the steady increase of members during last session.

The new session opens with prospects of even greater success. The list of new members to be proposed is a large one, and the promises of papers are very numerous. From every side the most cordial support of well-known astronomers has been received. The great object the council have had in view is to keep the subscriptions as low as possible, in order that no one may be prevented from joining. In spite of the comparatively small number of members, and thanks to the devotion of some of those members, the society commences its new session free from debt, I hear. Of course, the more numerous the members the more secure the society is from pecuniary difficulties. Indeed, a point must be shortly reached when the balance will be on the right side, and allow of sums of money being laid by for the foundation of a permanent observatory for practical astronomy.

I need hardly say what a cordial reception all readers of the ENGLISH MECHANIC receive, for we all remember that the idea of the society originated with some of "ours." **T. E. Espin.**

Observatory of the Liverpool Astronomical Society, West Kirby, Birkenhead, Sept. 17.

TRANSFER OF THOUGHT.

[21856.]—PROBABLY "Kappa" (21836, p. 67) is correct in saying we have had almost enough of this subject. A dicussion is rather difficult when it consists in one side bringing forward statements of facts demonstrated by careful observation, and in the other simply saying they do not believe such things can occur they are inconsistent with the notions they have formed, or that someone else has published a different opinion, and so on.

For instance, does "Kappa" think that it is legitimate argument, or even commonly civil, to say "even 'Sigma' has gone wrong," merely because he cannot see the truth I have attained to? I have given clear statements of *facts which I have observed* and carefully analysed, and I think I am perfectly capable of careful observation of facts, and that my opinions, based upon those actually observed facts, are likely to be more trustworthy than that of people who, not having witnessed the facts, refuse to believe them, or even to consider how far they are probable, merely because they differ from their own prejudices. If I stood alone, there might be some reason in this; but what I say agrees with what is said by everyone who has really examined the facts. It is wholly those who have either not examined at all, or who have incompletely examined, who deny them.

"Kappa" givet us just the same common folly in witnessing the very interesting statement of Mr. Carter's experiments. He compares the old game in which *external assistance is given to the seeker*, and the result is due to the sharpness of the player in following that indication, to a case in which *no such assistance is given*, and then he commits the gross impertinence of *assuming fraud or trickery*. Now, my own actual experience in these matters enables me to say that those young ladies possess those natural qualities which I explained years ago as constituting the "seer" or receptive constitution. I am perfectly certain that, under proper management, they would read the contents of a sealed letter, such contents being known to the person holding it, and such person honestly fulfilling, and being capable of fulfilling, the conditions. It is because all these different conditions must unite, and that they are all and each of them rarely found, that it is so difficult to obtain experimental evidence of the higher forms of thought transfer. And such evidence is powerless where people are determined to assume fraud and conspiracy in the parties to the experiment, and credulity and eagerness to believe in the observers. However, I am well aware that the facts are becoming widely known and deeply interesting to many, and I believe the evidence I have been able to give has made a great many people recognise that there is an important and unknown power in our nature, deserving of serious thought and investigation: so I care very little for the opinions of those whose mental eyes being unable to bear the light of truth, prefer to shut them.

Now, in reply to "F. W. H." (21837, p. 66), I have never said a word against scientific investigation, or denied the right to find out physical causes, &c. What I have protested against is the denial of facts and refusal to look at them. No cientist has ever yet given the faintest evidence that thought *is* a motion of molecules of matter. All that anyone has shown is that such a motion is an accompaniment of thought. But he is a presumptuous man, and not a scientist, in that respect, who asserts as a fact what is nothing more than his own prejudice—for it is prejudice. Those who assert this statement as to thought, go to their investigations determined to seek support for the pre-judged opinion. But all their facts are just as well explained as consequences of thought—as actions accompanying thought, not as being the agent.

As to the P. S., I beg to remind "F. W. H." that it was not *the* writer of old who *also* says that "man has no pre-eminence above the beast." The statement I referred to was by a different writer, and by one of a very different order of mind. It is very uncertain who was the writer of "Ecclesiastes," and it is considered that it was written during a period of national degradation and individual hopelesness. In fact, it is an early example of the lately revived doctrines of Pessimism, and of the question "Is life worth living?" Now, that question has been answerd by a pun: "It depends upon the liver." It does: if a man is a martyr to dyspepsia on the one hand, or if his mental and moral nature cannot rise above the mere animal routine, life is not worth living.

Now, if Solomon wrote "Ecclesiastes," he did it after he had ruined his constitution by excesses, and worn out his temper and spirits by squabbling with his thousand wives, and degraded his moral nature by conscious wrongdoing and idolatry, in defiance of his own wisdom. I do not attach the smallest weight to the dismal wailings of a man suffering from such a complication of physical, mental, and moral diseases. On the other hand, I am inclined to think that the writer (be he who he may) intended to paint the worst picture of life, such as it might be regarded by men either suffering under the evils of the most tyrannous and corrupt government, or the still worse evil government of their own utterly selfish passions. I think he did this with the deliberate intention of leading to the final teaching following those striking words: "Then shall the dust return to the earth as it was, and the spirit shall return to the God who gave it": words, be it seen, very inconsistent with the apparent sense of the parts from which "F. W. H." quotes, though even among them are to be found many a vivid gleam of higher and nobler thought. With all his apparent despair of life and doubt of man's nature, it will not do to quote the writer of "As thou knowest not the way of the spirit, nor how the bones grow in the womb of her that is with child, even so thou knowest not the works of God who maketh all," as a supporter of the "great German scientists" who pretend to know all about it, and deny the existence of that spirit because they know not its ways. It is not by taking isolated remarks that a writer's spirit is to be discerned.

Sigma.

[21857.]—"SIGMA," I hope, though he may think with me "Nihil humanum a me alienum esse puto" will accept the above advice from one who has passed the Biblical three score and ten some years, and which is offered *sine ire et odio*, and with the greatest regard for "Sigma's" distinguished talents in general, and as an electrician in particular. In talking of presumption and ignorance of other earnest investigators, "Sigma" descends below his level, and joins in the chorus of abuse heaped upon such men as Darwin, Huxley, Tyndall, Strauss, Rénan, Colenso, and a host of other inquirers after truth. I should be sorry to reckon "Sigma" amongst this class of thinkers, on which the simple mention of any of these great men acts as the dangling of a red rag before the eyes of a mad bull. I remember what a godsend it was to this class of men, when the existence of the famous "Acarus Crossii" was disproved, a fact asserted as such in that remarkable though well-abused book, "The History of the Vestiges of creation" (I believe generally attributed to Dr. Chambers). I often heard my friend Dr. Elliotson "piæ memoriæ" complain of the abuse he suffered because he was a believer in unpractised mesmerism, and of whom people said in contempt: "Oh! You mean the man who goes about with a piece of wood to apply to the chests of his patients." It would be difficult nowadays to find amongst the medical profession one who does not think this piece of wood an indispensable, great boon of "Laennec." But "revenons à nos moutons," as our neighbours say. Might I ask "Sigma" if he understands German, or if his knowledge of Moleschott is only second-hand, whom he accuses of presumption and ignorance for saying "Thought is motion of atoms"? Will he permit me to refer to another quasi-paradoxical saying of Moleschott which excited the gentle ridicule and sarcasm of Liebig—viz., "No thought without phosphor?" Yet, as far as I remember, this great chemist, though bad biologist, had the worst of the argument, after Gobley proved that the brain contains a fat which, treated by mineral acids, and alkalies, is decomposed into margarin and phosphor-glycerine; and Liebig himself acknowledges that the brain and nervin matter contain phosphor, without which their development is arrested, and thus Moleschott's dictum, "No thought without phosphor," seems justified. Du Bois-Reymond, whose work on animal electricity "Sigma" no doubt knows by heart, was, I believe, the first who proved that in all nerves an electric stream is present. Nerves are the cause of the shortening of the muscular fibres which result in *motion*. Nerves are the mediators of all sensations. Impressions arrive only at consciousness when they are transmitted to the brain. Du Bois-R. further asserts that every action in the nerves, which in muscles effects motion, is perceived in the brain as sensation, and is accompanied by a change in the electric state of the nerves. In the moment of motion or sensation, the electric stream suffers a diminution, produces a chemical change in the conducting medium, similar as we decompose water into oxygen and hydrogen by electricity—every change in the state of the nerves involves a change of its atoms. Davy and Bärensprung affirm that mental activity causes hunger, and augments the breath of the body. Hunger is a sure sign of wasted powers, of poverty of the vital fluid, which cannot otherwise be explained, as by an increased metamorphosis of elements, due to a heightened activity of the brain during the strain of thinking. While awake, a greater mass of blood circulates in the brain than when asleep; observe the head of an infant while asleep. The fontanel appears as a great depression, while, when awake, it appears quite *arched*, on account of the increase in the blood of the brain. In fact, every increase in the function of an organ is due to a greater influx of blood to this organ. During digestion, the stomach is in a state of congestion as it were, and on its completion, a reflux through the venæ breves to the spleen takes place. Thus, Moleschott came to say "thought is a motion of matter." During thought, the brain becomes a centre of attraction for the circulation, and with it a more active change and metamorphosis is the necessary consequence.

Continuing your lecture of Mr. Craven, I might say, and say truly, we do not see the objects themselves, which might seem strange to the uninitiated. My clinical teacher in 1828 already talked of food for the lungs, in anticipation of what now every schoolboy accepts as reasonable. V. Hardenberg ("Salis" the poet) defined philosophy as a desire to be everywhere at home. Nobody would take this as meant for a proper definition—yet it was the thoughtful expression of an amiable poet. I should have thought thus also Moleschott's expressions might have passed without exciting ire and obloquy. Give to everybody credit for an honest desire of arriving at the truth. I often think what a good thing it is that the highest problems of humanity are involved in doubt, thus stimulating the noblest minds to find a solution of them as far as they are able; without this, there would be but a stagnant pool of decay. Even in the presidential address of Professor Cayley the old vexed question of innate ideas of time and space, which we discussed as schoolboys, return as objects for discussion, and will return as long as the world is as we find it.

Apologising for the length of these remarks—you know old men are garrulous: but I will promise to bear any punishment that may be in store for me meekly, and not enter on any discussion.

September 25. **F. D.**

[21858.]—DOES "Sigma" (letter 21712) mean to say that ether and chloroform have the same effect as mesmerism? Do they not act on us in a measure so as to stay the circulation, and is it not the case that sometimes the heart is too weak to put things right again, and so the patient dies? In fact, do they not really act by partly destroying life, and does not the pulse tell one so? Is this the action of so-called mesmerism?

E. T. Scott.

[21859.]—THE dogmatic tone adopted by our valued correspondent, "Sigma," in the discussion on thought transfer has surprised me very much; and his statement that "all the Haeckels, Buchners, and Moleschotts put together will never convince me that any combination or motions of atoms of carbon, hydrogen, or nitrogen ever worked a problem in Euclid," can only be bracketed with the remark of the old woman, who said she was open to conviction, but would like very much to see the person who could convince her.

"Sigma" may, of course, believe that the phenomena of life and mind are due to an extra-material principle; but the conclusions of science do *not* favour that view. Will "Sigma" assert that botanists believe anything except matter exists in plants? Scarcely, I think; and if the phenomena of plant life can be produced by matter alone, why not animal life, even in its highest forms, as well? Go into a conservatory, "Sigma," sit down, and try to realise that the floral beauty around you is only matter. Look at a hyacinth bulb; remember that there is nothing in it except matter; think what it will do if planted; try to form some conception as to the molecular machinery of the bulb—I do not think you will succeed. I am doubtful as to whether anyone will ever succeed; but the exercise may at least teach you not to dogmatise on what matter can or cannot do. "Sigma" may argue that plants do not think: granted, but if the phenomena of life be once admitted as produced by matter, *there is no logical halting place*, no spot where we can say, "Behind this is only matter, but higher up is something else." Whether my friend likes it or not, whether it will square with his beliefs or not, and whether he will admit it or not, the fact remains that the tendency of modern investigation is to glorify matter, and to send the "vital fluid" to keep company with the caloric fluid, the electrical fluid, &c., in the invention of which the old schoolmen displayed such fertile imagination, and such utter lack of experimental knowledge. Of course, we do not know *how* the brain thinks: but it will be quite time enough to attempt that problem when we have learnt *how* sugar is sweet, acetic acid sour, bichromate of potash red, and chrome alum violet-green. We do not know the *how* in any of these cases, but no one (excepting now and then an elementary science student) thinks there is a principle of sweetness in sugar or of sourness in acetic acid. The fact that we cannot understand how the brain thinks has no argumentative value whatever; in attempting to understand it we are probably [illegible] into the position of an express engine trying to comprehend the cause of its own splendid strength.

In conclusion, I would like to intimate to "Sigma" my regret at the [illegible] he seems to have taken up, and to assure him that a desire for further truth is my only object in writing.

Wm. John Grey.

Elswick [illegible] School.

TRANSFER OF THOUGHT—TO MR. CARTER

[illegible]—[illegible] appears to be aware that children [illegible] very quickly [illegible] a single [illegible] and [illegible] two fingers [illegible] each [illegible] your friend is [illegible] I know of a case where a [illegible] certain letters of the [illegible] thumb and fore- [illegible] of this kind.

K.

[illegible] at the remarks of "Sigma" [illegible] about his [illegible] scientific [illegible] of scientists as [illegible] world works, and [illegible] scientists [illegible] their so-called [illegible] and more important [illegible] stated by "Sigma" as ascertained [illegible]

It is equally useless to pervert the sense of the argument of an opponent, which "Sigma" certainly endeavours to do in stating "if certain views be true, &c., there can be no thought at all." In all the writings of Moleschott there is not a line from which such a conclusion could be logically drawn. The very words quoted declare not that thought cannot be, but the means of its origination are referred to motion in matter (brain matter).

F. W. H.

[illegible]—INTELLIGENT readers of the ENGLISH MECHANIC will regret that so much valuable space has been taken up by "Sigma" in explaining that which we all learned in our schooldays. (21835) "Sigma" tells us that a man loses sight if a cataract forms; (2179?), also, that one cannot see in a mesmeric trance, with the eyes closed, and the eyeballs turned up to the skull; (21712) and yet, he says, it is possible, under "certain conceivable conditions," to see with the tips of our fingers; [illegible] surely it would not be difficult for one who has "lifted the veil of a tremendous mystery" [illegible] to explain [illegible] these "conceivable conditions" [illegible], and thus settle the matter.

T. E. D. Craven.

[2186.] I ATTENDED some experiments in thought reading which had interested me, and "Kappa" [illegible] comes forward to explain that I have been imposed upon. But if this covers my case, it will cover the thousand and one precisely similar which happen every day; so cease your [illegible], "Sigma," and the rest. A Daniel has come to judgment, to teach you "how it is done." It is all a matter of "tapping." One tap, "you're cold"; two taps, "you burn"; three taps, "you've got it," or, at least, you should have, according to the [illegible] authority. Here is [illegible] [illegible]. *But will "Kappa" go a little more into detail,* as I do not even now quite understand. The children to whom I have alluded, and to whom I read "Kappa's" letter on Saturday evening, much to their amusement, tell me that so far from being peculiar to themselves, the exception is to find anyone who cannot do it, and they named half a dozen friends whom I know, and who have tried it since I saw them, with perfect success. Now, if it is a case of auctioneer's "tapping," each of these, as well as themselves, must have been instructed in the code of signals before commencing: but as there would be only themselves to be amused, and each would be in the secret, the fun must be rather slow. My young relations make it an evening amusement among themselves when they are quite alone: but it would seem a little absurd for one to be tapping when all could do it alike. It is as if three or four conjurors should get together one evening to exhibit the feat of legerdemain which are the common stock in trade of all. Then, again, as I suggested what should be done in the absence of the child, and not a word was spoken after her return, it is strange that the taps which must have been audible to her, should have been unheard by me: perhaps, however, they were peculiar—"Kappa taps," I may call them—which could not be heard. And Jack's "private signal with her sisters" is also greatly in need of explanation, for I blindfolded and led her out of the room, and how, in the deep silence, she was made to understand that I had put a thimble in a box in her absence, is a mystery which only "Kappa" can fathom.

I am almost ashamed of refuting these absurdities, for I must repeat that "Kappa" must mean them for a general explanation of the phenomena. The children have exhibited the power to many besides myself, and others, to their surprise, have done the same things. Here are men like Tyndall or "Sigma," engaged in an earnest inquiry, under conditions to preclude imposture, into this matter of thought reading, and in comes this flippant "Kappa," who probably has never given half an hour's consideration to the subject, and explains all by the Christmas game of "Auctioneer!"

The courteous suggestion of "Sigma" in the last number, that the results I described (21805) should be tested without contact with the subject, has been acted upon, but without success. It may be due to an imperfect mode of applying the test. I did not witness it, but was told it did not succeed. The slightest contact, however, of one person is sufficient for the purpose.

"Sigma's" suggestion that unconscious muscular guidance may account for the phenomena, is very likely correct, but it does not seem to me to cover all the facts, for if the direction of the subject is thus caused, the hands and arms are free and unrestrained, and the action of the subject appears to be spontaneous. As an experiment the other evening, I hid a thin card under the cloth of a large dining table, which I willed the child should find and place under a newspaper on another table. She walked round the table twice, stopping at length near the place where the card was concealed; but on the hypothesis advanced, I do not see why she should have made the second journey. I shall be glad, however, to accept any explanation which does not insult common-sense, like the suggestion of "Kappa," to which I have separately referred. I may add that the thing alluded to was done, as also another, which bordered on the ludicrous. I suggested that one of the other children who was absent from the room should, when blindfolded, take a piece of sugar out of a basin, place it first on the sill of the open window, and then throw it out. Everything was done exactly as I had willed, and as the child dropped the piece of sugar into the garden after its temporary rest on the sill, she exclaimed, "What a waste"!

T. H. Carter.

[21861.]—I was just going to the house of a friend on Friday evening last when I read, in the "E. M.", the interesting letter of Mr. T. H. Carter, No. 21805, and as we were to have a performance of a very similar character, I thought you might be interested in a few notes upon the subject. The *Notes* were taken by a bank teller who was present. I am the Congregational Minister referred to, and gladly offer my testimony to the accuracy of the notes. The blindfolding was done by ourselves, and consisted of a strip of black cloth cut with a bridge for the nose, so that the side pieces could hang down upon the eyes and cheeks. Over this a silk handkerchief was carefully bound. No word was spoken while the girl was undergoing the tests, and the father was carefully watched to see that he gave no hint or help of any kind to his daughter. The child is an interesting and well behaved girl, the daughter of a working man in Manchester. Her education has only been such as such girls usually get. The entertainment was got up by a gentleman of well-known character and probity in the neighbourhood, and who is well known in Manchester, his object being to afford himself and a few friends a quiet opportunity of judging for themselves. In every case the tests were entirely successful as described, especial praise being due to the skill—or whatever it is—with which she read the cards upside-down and put them perfectly straight in their places.

The Congregational Minister.

Sept. 18, 1883.

Notes of an Exhibition of Thought Transfer, Second Sight, &c., given by Miss Lilian B. (age 11 years), at the residence of J. B., Esq., on Friday evening, Feb. 14.

Present, a party of 19 ladies and gentlemen, including a Congregational minister, a doctor of medicine, a bank manager and two gentlemen of considerable experience in legerdemain—all anxious for honest investigation and keen to detect trickery.

The performer was carefully blindfolded, and in her absence it was decided that the first tests should be (1) An indication of the position of the ladies in the room, and also of all the bald-headed gentlemen. (2) A jug filled with water was to be placed upon the table—also a glass—and a gentleman was to be selected to whom the glass of water should be offered.

Result—On being brought into the room blindfolded, and without being in personal contact with anyone, the performer (1) pointed to all the ladies in the room; (2) indicated the baldheaded gentlemen (three in number); (3) found the jug and glass; (4) filled the glass with water; (5) and handed it to the gentleman who had been selected. Time 7 minutes.

Again Miss B. was conducted out of the room. A rack or stand covered with black velvet was then placed upon the table, and on the top ridge (which was quite six inches above the level of the performer's eyes) letters were placed representing the word *Albert*, which had been chosen by those present. Over 200 letters were then thrown down indiscriminately upon the table, face upwards.

Result—Miss B. advanced to the table, picked out in succession from the heap of letters A L B E R T, and placed them on a ridge of the stand immediately under the letters already placed there by the company. No personal contact again. Time 5½ minutes.

The name of the town was then chosen, but not placed upon the stand, and more quickly than before the letters forming the word were picked out from the heap and put upon the board by the performer. With a view to disconcert her, the letter O was removed from the word she was forming, but the blank space left by the missing letter was noted at once. Time 4½ minutes.

It was observed that Miss B. placed the Y (one of the letters of the word) upon the board before the E, but she did not fail to leave an open space for the insertion of the E. The only explanation of the Y being used first was that it happened to be observed first from amongst the letters on the table.

A hand at whist was decided upon as a further test.

On being brought into the room the performer (without being told where to sit) walked to the vacant seat left for her at the table.

The game proceeded and, blindfold, and without contact, she unhesitatingly played the right card whenever her turn came round—the result even under the strange condition of blindfoldedness, being that she and her partner won the hand. On being asked why she played a trump card she replied, "Why, to beat them!" Time, 9 minutes.

The whist test concluded, the 52 cards were spread out on the table face upwards, and the performer agreed to pick out any card named.

The Queen of Hearts was asked for and found in exactly two minutes. The eight of hearts in 3½ minutes. The spade ace in 1½ minute.

A more difficult test followed. The cards were arranged in suits and laid in rows on the table. Each row began with the ace (counted as *one*) and went on progressively according to the number of spots.

Four cards were taken up, here and there, from those on the table by four separate persons, and, after being well shuffled, were placed face *downwards* in the hands of the performer. Advancing to the table, she put the four cards back in their places without the slightest approach to a mistake. Time 3 minutes.

Having been taken out of the room, she was again admitted to find a concealed box of chocolate. The box was found without hesitation. Time 3 minutes.

After working hard for an hour and a half in this way, it was only natural that a child of eleven should complain of exhaustion, but she consented nevertheless to attempt the finding of a concealed pin *à la* Bishop. Twice in succession she found the *locale* of the hidden article, but did not attempt to pick it up, not apparently being quite sure of the object. The third time, however, when the pin was pricked into a black silk cushion and placed on the table, she found it without much effort, taking it up quickly and without hesitation between finger and thumb.

Everything during the evening was accomplished without the least personal contact. The only help (if help it be) was given to her by her father, who stood near (but never touched) her, and the assistance appeared to consist merely in the concentration of his mind and eye upon the various objects with which the child was dealing.

A PENNY WATER CLEANER.

[21865.]—THE writer is very much pleased with Mr. Fredk. Guthrie's-letter containing a description of the above. His remarks are very good and valuable. But it is possible that harm may be done if people were to allow the water to drop slowly direct from the service tap, as is so very easy to do. I will tell you how. Some time since, in a town not far from Manchester, a cotton mill operative and his family were taken ill; the doctor was called in; he was puzzled with certain symptoms which were very unusual among mill hands; he prescribed suitable remedies, but his patients got no better. During one of his visits he noticed the water regularly dropping from the tap, and being caught in a clean vessel. He asked what they did this for. "Because," they answered, "the water was so nice and clear; indeed, it is better than if filtered, and we always use it." The family were suffering from lead poisoning.

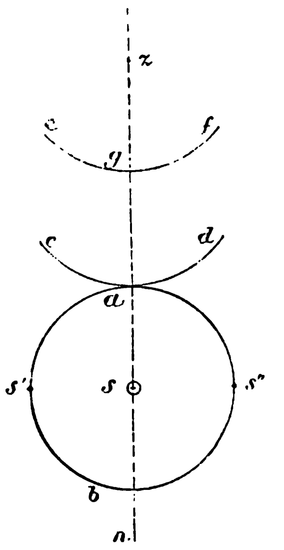
Any reader can easily avoid such an unfortunate occurrence. Lead pipes are often tin lined now, but I would not trust them as narrated above.

W. B.

PARHELIA.

[21866.]—YESTERDAY afternoon (Sept. 9th, 3.30 P.M.) I witnessed a parhelion of some peculiarity, which is perhaps worthy of being recorded.

In the subjoined diagram Z N represents a plane through the spectator to sun, S, and zenith. S′ S″ two mock suns, bright, and possessing slight prismatic colouring, red being in both cases towards the sun.



A B a circle of white light passing through the mock suns, and fainter at the bottom than the top.

C D a small portion of another circle of bright white light meeting the other circle at the point A.

At a distance A G, about equal to A S, was a portion of a third circle, E F, coloured like the rainbow, with the red towards the sun. This was very brilliant.

The centres of all the circles appeared to be in the plane Z N.

The diameter of the circle A B was about 25°. Long., 1° 14′ W. Lat., 60° N. Barometer, 30·025. Thermometer, 53. Wind, S., light. Weather fair. To-day Sept. 10th—Barometer, 29·850. Thermometer, 50°. Wind, S. E., fresh. Heavy rain.

Edward M. Nelson,
Sandwick, Shetland, N. B.

DR. EDMUNDS ON SCREW PITCHES.

[21867.]—IN Dr. Edmunds' recent paper on screw pitches, &c., in the *Journal* of the Amateur Mechanical Society, referred to in the first article of the ENGLISH MECHANIC for September 7, he reproduces from Holtzapffel's IVth volume a sketch of a male screw, a copy of which is shown here (Fig. 1), and states that it may be taken as Mr. Holtzapffel's ideal of a mandrel nose. It is difficult to conceive how Dr. Edmunds can have thought of doing that gentleman such an injustice. Mr. H., in giving general instructions for the formation of a screw on the lathe, draws attention to certain points, and, to illustrate his meaning, gives a rough sketch of a screw, in which these particulars are shown in a somewhat exaggerated form; but nowhere does he state that this is the form he approves of for mandrel noses, nor does it in the least resemble those supplied by the excellent firm of which he is the head. In Fig. 2 I give a sufficiently accurate sketch of one of Messrs. Holtzapffel and Co.'s mandrel noses, the proportions of which will be seen to be as different from those of Fig. 1 as one screw can be from another.

G. C. C.

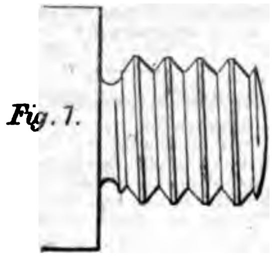


Fig. 1.

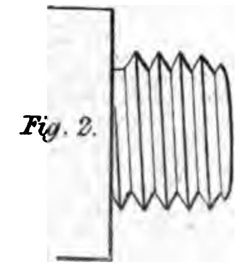


Fig. 2.

Length	$\frac{37}{64}$
Diameter at top of threads	$\frac{52}{64}$
Do. bottom ,,	$\frac{[illegible]}{64}$

THE THEORY AND CONSTRUCTION OF THE HELIOSTAT.

II.—Constructive.

[21868.]—A HELIOSTAT on Fahrenheit's principle may be very simply constructed as follows:—

Cut out a piece of wood about 18in. by 12 for a baseboard. This should be clamped; that is, it should be constructed like a drawing board with pieces match-planed on to the ends to prevent warping. If this is thought difficult, cross pieces may be screwed on underneath at each end, but one or other of these methods must be adopted, or the board will infallibly cast and spoil the whole instrument.

Next cut a piece of hard dry wood an inch thick to the shape of Fig. 1. This may be about 5in. wide, and say 7in. high; the only important point is that the angle A should be equal to the co-latitude of the place. Thus, if you live in London, which is about lat. 51½°, the angle A must be 90° − 51½° = 38½.

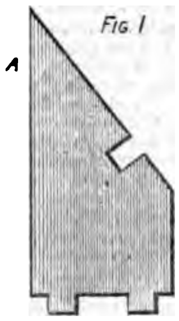


FIG 1

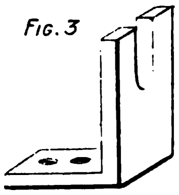


FIG. 3

Fix this piece to the baseboard by inserting the tenons into mortise holes, so that it may stand up at right angles parallel to one of the short sides of the baseboard and about 6in. from it.

Now take a piece of bright steel rod about ⅛ to ¼in. in diameter, and one inch longer than the slant side of the small piece of wood last described, and insert the end to the depth of about ¾in. into the end of a piece of wood of the shape of A B, Fig. 2, taking care that the hole is bored axially in the wood.

Next turn out of box, o some other hard wood, two small pulleys with V grooves, taking care that the diameter of one measured to the bottom of the groove is exactly double that of the other, and bore through the centre of the larger of the two a hole of such a size that it will drive tightly over the steel rod (see Fig. 2).

Now obtain a piece of good looking-glass, not too thick, and about 7in. by 3in., and attach to the back of it a piece of thin wood slightly larger than the glass, to enable you to fasten the looking-glass down to it with round-headed screws over the edge. To the middle of the back of this piece of wood fasten another piece of the shape shown in the figure. This is to be attached to the piece of wood at the end of the steel rod by a small thumb-screw, to be purchased at any ironmonger's. Fig. 2 will show the whole disposition. P is a small protractor fastened to the wood at the back of the looking-glass, and which will enable you to set the glass with sufficient accuracy. The glass is capable of being turned round the thumbscrew, and by it fixed in any desired position.

Now fasten on to the stout edge of the piece (Fig. 1) two little pieces of sheet brass of the shape of Fig. 3, so that the steel rod (which we will now call the "polar axis") may turn easily, the pulley dropping into the notch of Fig. 1. A small screw at the lower end of the slant side of Fig. 1 will keep the polar axis in place and prevent the pulley hanging against the side of the notch; and if the polar axis shows any disposition to overbalance, a small staple may be driven over it.

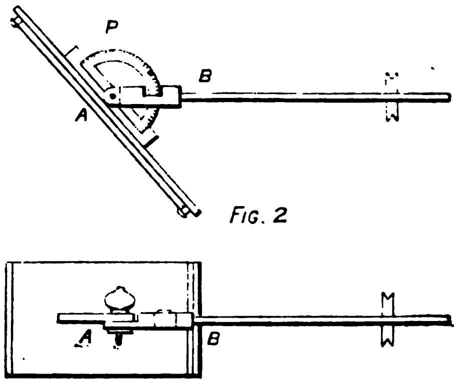


FIG. 2

Now fasten down to the unoccupied end of the baseboard a small American clock. This may be purchased at Clerkenwell (or through any watch-maker) for about 4s. 6d. Before fastening it down, however, drive on to the hollow axis of the hour hand the smaller of the two boxwood pulleys. A band of thin string or catgut will now put the whole thing into gear. It will be better, however, not to fasten the clock directly to the baseboard, but to an independent stand, with a slot in it, through which and a hole in the baseboard, a thumbscrew can be passed. This will enable you to regulate the tension of the string that the movement may be easy and without slip.

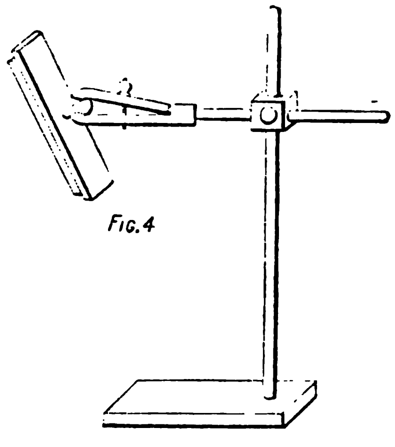


FIG. 4

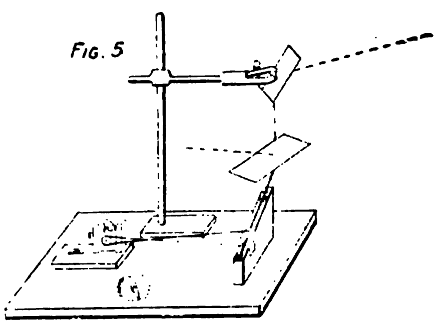


FIG. 5

If a clock with a pendulum be chosen, a hole must be cut in the baseboard to allow the pendulum to pass through, and the baseboard must be mounted lap of valve, to this add the required compasses to that distance and mark below line B and parallel to same, circle on each side, now from centre C and D, extending them to the edge, project these lines along and parallel position required, draw the centre line entries and put them on the shaft, lines to those on the shaft: this will position for forward and backward.

— **Pneumatic Tubes.**— Composition material you can use. This can be any gasfitter. If you have not a r you, it will be an easy matter to get ndon, Birmingham, or other large towns. NCASTER.

— **Signal Boxes.**—The signal boxes on Railway are provided by the telegraph with oval-shaped boards. They are ne and sometimes white on one side, and a white line across on the other side. If raph apparatus are in good order the shown, but if any defect occurs in the block instruments the board is shown

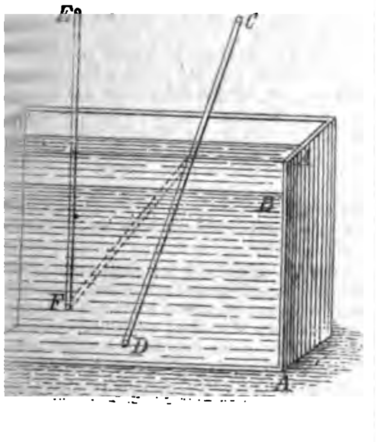
0

, &c., it is shown thus—

⬭

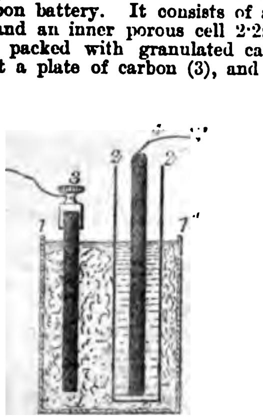
f these boards is to get the lineman's ho may go by in a train, and who keeps out for such evidence of any defect.— MAN.

Light.—You can make a very simple ting apparatus for exhibiting the re- light as follows:—Make a rectangular ack, ends, and bottom of wood, having a A A A A and with top open. Fill with



to the line B B. When placed on the ble the glass front should face the audi- lecturer takes the rod C, and passes it down into the water till it touches the bottom of at D. A second rod E is put in the hand of e audience with a request that he will, look- n from the top, indicate the position of the which he will do by placing the point of t F.—R. B.

.]—**A Three-Cell Battery.**—I should "Physis" to construct three cells of the carbon battery. It consists of an outer in., and an inner porous cell 2·2in. The ell is packed with granulated carbon, in is put a plate of carbon (3), and charged



a solution of bichromate of potash and iatic acid. The inner cell contains a zinc rod ylinder (4) in a solution of chloride of ammo- m and muriatic acid. Three of the cells (outer 10in. high) will light a 3 candle-power lamp. is battery requires recharging every five or six weeks: the old solutions should be thrown away, and the battery well washed in plenty of water before charging it with the new solutions. These cells can be sealed and used for electro-plating, firing fuses, working medical coils, electromotors, and for incandescent lighting.—ELECTRICIAN.

[51660.]—**Double Dark Slide.**—To MR. LANCASTER.—You shall have instructions with drawings in a week or so. Meanwhile, if there is any question you would wish answered, I shall be pleased to answer it. I am really sorry that my time is so limited, or rather that all of it is used up, and that I have to snatch a moment from sleep to write a short answer now and again. I would willingly write more and more, but at present it is quite an impossibility. The drawings of different parts of slides have occupied some time, and, if they were finished, I would send article on at once; but I promise you if I cannot finish the drawings this week, I will get a draughtsman to do them.—W. J. LANCASTER.

[51664.]—**Prepared Ferrotype Plates.**—To MR. LANCASTER.—You can prepare ferrotype plates, but cui bono, when you cannot produce a positive upon them? If you want to take negatives and transfer the gelatine on to glass, then the ferrotype plates may be used; but if you wish to take positives they are useless.—W. J. LANCASTER.

[51670.]—**Gravity and Equilibrium.**—There is no mechanical work done in keeping a weight of whatever magnitude in a fixed position.—WM. JOHN GREY, Elswick Science School.

[51670.]—**Gravity and Equilibrium.**—Let air = $\frac{1}{820}$th the density of water, and g = 32ft.; then it would take 62·577 horse-power to sustain 112lb. spread over 1 square foot of surface; but it would only take half the horse-power named if the 112lb. were spread over 4 square feet of surface, one-quarter if over 16 square feet, and so on. The principle being the same as that by which $\frac{1}{4}$, &c., "head" water will only give $\frac{1}{4}$ pressure, $\frac{1}{2}$ velocity, or $\frac{1}{8}$th work, and so on.—G. PINNINGTON.

[51679.]—**Indiarubber Gaspipe.**—Throw it away and buy the black indiarubber tube. This will not smell, and will last much longer than the common tube—W. J. LANCASTER.

[51686.]—**Christianity.**—The date of the introduction of Christianity into England cannot be accurately determined. It is known for a certainty that St. Alban was the proto-martyr for Christ in Britain, and that his death took place at Verulam at the beginning of the fourth century. Some authorities say that Christianity was professed in this country as early as A.D. 61; but much uncertainty prevails on the subject.—W. HENLEY RICHMOND.

[51687.] — **Railways Speed.** — The average speed of the Irish mail, and the Scotch limited mail is, as near as possible, between 39 and 40 miles an hour, including stoppages. Of the Highland express I know nothing.—MACHINA.

[51687.]—**Railway Speed.**—The average speed of (1) the Irish Mail, including stoppages, is $\frac{263}{395} \times \frac{60}{1} = \frac{263}{79} \times \frac{12}{1} = 39\frac{75}{79}$. Excluding stoppages it is $\frac{263}{367} \times \frac{60}{1} = 42\frac{366}{367}$ miles per hour. This is the train leaving Euston 7.15 a.m. (2) That of the Scotch Mail, including stoppages, is $41\frac{1}{430}$ miles per hour, and, excluding stoppages, $43\frac{71}{113}$. This is the train leaving Carlisle 8.46 p.m., which takes one minute less than the down mail. The Highland Express averages, including stoppages, $39\frac{3}{31}$; excluding stoppages, $42\frac{66}{427}$ miles per hour. The above are all upon the L.N.W. The Caledonian, between Carstairs and Carlisle, reaches an average of 48 on the up mail, and 43 on the "Highland." If "Euskarian" will turn to Bradshaw, he will find what he requires.—W. THOMPSON.

[51689.]—**Spectacles.**—The better thing for you to do is to go to some respectable optician who knows his business—I don't mean a simple spectacle seller—and get the glasses you require. From your description you ought to have two glasses of different foci, but the exact difference required it is impossible for me to tell you. You need not have glasses so deep as to enable you to see distinctly miles away, better wear those that give you sharpest definition 100 yards away; then get the natural accommodation of your eyes to do the rest. There are cases in which the eye becomes more convex with age, but they are rare; the majority of cases gradually getting less convex.—W. J. LANCASTER.

[51690.]—**Metaphysics** has been wittily defined as one man trying to explain something which he knows nothing about, to another man who cannot understand a word he says. Had you not better take up something useful?—WM. JOHN GREY, Elswick Science School.

[51692.]—**Photography.**—A good intensifier for over-exposed plates is—

Bichloride of mercury	1oz.
Distilled water	20oz.

Powder the mercury and dissolve.

After well washing the negative, place in a tray, and cover with above, and allow to remain until the negative appears white at the back. Wash for half an hour, and then place in a tray and cover with 3oz. water and 15 drops of ammonia; when the whole is black again, take out and wash well, and it is then finished.—P. J. DEBNAM.

[51694.]—**Lawn Tennis Court.**—I had an asphalte tennis court made which cost about £60, including the necessary excavation, 14in. of concrete. If "H. B." is charged £100 for simply a coat of asphalte, he must be, to say the least of it, the victim of some very unprincipled person. The work he requires ought not to cost more than £25 or £30 done by professionals, and perhaps less, if done by some local gas company. I shall be happy to give any more information I can, if "H. B." should require it.—K. W.

[51694.]—**Lawn Tennis Court.**—Perhaps the person from whom you purchased had intended to give the concrete another layer of a smoother type. It would be well to find out from him, if you could, what his intentions were as to this; as if too rough for you to use, it was also so presumably to him. What I would suggest would be to jag up the concrete that is there, and give it another layer of fine concrete to a good depth—say, 4in. or so—to prevent cracking or flaking. Any builder ought to be able to do this for you for far less than the sum you name. I should say that if you only have one playing space to do, he ought to do it very nicely for £10 or £15.—SEMPER FIDELIS.

[51695.]—**Pot Pourri.**—This is a mixture of dried flowers and spices not ground. Dried lavender and whole rose leaves, 1lb. each; crushed orris, $\frac{1}{2}$lb.; broken cloves, broken cinnamon, and broken allspice, 2oz. each; table salt, 1lb. We need scarcely observe that the salt is only used to increase the bulk and weight of the product in order to sell it cheap. There is a similar preparation, Olla Podrida.—(From "Art of Perfumery"—Piesse). —J. W. LONGFIELD, 111, Manningham-lane, Bradford.

[51695.]—**Pot Pourri.**—Put into a large china jar in layers the following ingredients, with bay salt strewed between the layers:—Two pecks of damask roses, part in buds and part blown; violets, orange-flowers, and jasmine, one handful of each; sliced orris-root, Benjamin and storax, two ounces of each; a quarter of an ounce of musk, a quarter of a pound of sliced angelica-root, a quart of the red parts of clove gillyflowers, two handfuls of lavender flowers, rosemary flowers, bay and laurel leaves, half a handful of each; three Seville oranges stuck as full of cloves as possible, dried in a cool oven, and pounded; half a handful of knotted marjoram, and two handfuls of balm of Gilead dried; cover all quite close. When it is uncovered the perfume is very fine. A quicker sort of sweet pot: —Take three handfuls each of orange-flowers, clove gillyflowers and damask roses; one each of knotted marjoram and lemon thyme, six bayleaves, one handful each of rosemary, myrtle, and lavender, half one of mint; the rind of a lemon, and a quarter of an ounce of cloves. Chop all, and put them in layers with pounded baysalt between up to the top of the jar. If all the ingredients cannot be got at once, put them in as you get them, always throwing in salt with every new article.—G. T. DENYER.

[51699.]—**Centre Board.**—In your case a simple and effective keel is easily fixed. Take a board of $1\frac{1}{2}$in. red deal, cut it to a segment, 2ft. to 3ft. base by 1ft. perpendicular; affix by two long bedscrews from inside. The keel may be taken off when afloat by withdrawing screws and plugging holes. —R. HANNEN.

[51699.]—**Centre Board.**—Get on board a sailing barge and ask the captain to put out his leeboards and explain to you the use of them. In the meantime you will be able to see about their construction, &c., which will do a youngster more good than a week's reading. He will explain all to you for a couple of glasses of grog.—A COUNTRY CHIP.

[51702.]—**To "The Kent Hermit."**—The information you require would occupy several numbers of this journal; therefore, I cannot give it. But it may probably appear in fragments in future numbers in reply to queries.—THE KENT HERMIT.

[51703.]—**Arithmetical.**—If, as I presume; the querist means a speed of 40 and 45 miles per hour respectively, the answer is 2·72min., for the faster train covers 440ft. per minute more than the other, and must thus occupy that time in passing the combined length of the two.—BETA.

[51703.]—**Arithmetical.**—The fast train moves through 3,960ft. per minute, the slow one moves through 3,520ft. in the same time; therefore the difference, or 440ft., is the distance gained in every minute, but the sum of the lengths of the two trains, or 1,200ft., is the entire distance which the fast train must gain on the slow one before it clears it. ∴ 440ft. : 1,200ft. :: 1min. : 2min. $43\frac{1}{2}$sec., very nearly.—EX-BLACKSMITH, Gorton Brook.

[51703.]—**Arithmetic.**—A train, 635ft. in length, traveling at a speed of 45 miles = 66ft. per second, overtakes another train, 565ft. in length, travelling at a speed of 40 miles = 58·6ft. per second showing a gain (in the former) of 7·3ft. per second. The combined lengths of trains 1,200ft., which [illegible] 7·3 [illegible] about 164secs., the time one train takes to clear the other.—Glasgow.

[51704.]—**Problem.**

Let x yards = length of wall built by A
100 − x " " " " B
Let y shillings = price per yard paid to A
y − 2 " " " " B
then x y = 160 [illegible]
and (100 − x)(y − 2) = [illegible]
Solving these equations we find x = 52·4[illegible]
y = [illegible]
E. F. L.

[51704.]—**Problem.**—This is more like a catch question than anything else. Solution: Since the money received by A and B [illegible] and since B receives [illegible] per yard for his work than A, therefore B [illegible] of the number of yards built by A. [illegible] yards built by A [illegible] yards built by B [illegible] = yards [illegible] shillings [illegible] = [illegible] per yard, and [illegible] per yard [illegible] the answers will [illegible] decimals.—[illegible].

[illegible]—**Sundial on Card.**—[illegible] E. M. [illegible] John Ha[illegible].

[illegible]—**Telephone Transmitter.**—The [illegible] works well [illegible] very well. By means of a switch [illegible] switched "off," and the [illegible] and receiver switched "on." You [illegible] anyone who has to do with [illegible]. Try to get some broken sticks [illegible] easily cut with a fret-saw and finished [illegible].—W. R. Ha[illegible].

[illegible]—**Electric Bells.**—You may add any [illegible] of same size. Don't [illegible] they will not work well together [illegible] them as nearly alike as you can. [illegible] and in future clean them once every three months. The zinc you have is evidently an impure sample.—W. J. Lancaster.

[illegible]—**Electric Bells.**—If you want more power, [illegible] of course add more cells. It is of small consequence what size or kind of Leclanche you use. Perhaps your zinc is cast, and, therefore, [illegible] it may be badly amalgamated, or your [illegible] may not be so good as it might be. [illegible]

[illegible]—**Padding Flute.**—The best way is to try the instrument after being corked up at the end with tobacco smoke, this will show any leakage. [illegible] As to pads, I use flannel, and when [illegible] whether two or three thicknesses [illegible] been used. I usually find that [illegible] to renew one key, it is best to pad all the [illegible] at once.—V[illegible].

[illegible]—**Removing Ink.**—Try some very dilute [illegible].

[illegible]—**Removing Ink.**—Solution of oxalic acid [illegible] at once. Solution of chloride of lime does the same.—R. A. R. B[illegible].

[illegible]—**Fluorspar.**—Fluorspar will not scratch window glass, but quartz will readily do so. [illegible] Put a little of the powdered mineral in a leaden spoon, add a few drops of sulphuric acid, cover with a piece of glass coated with beeswax, through which your name has been traced with blunt-pointed needle; now warm spoon gently (so as not to melt the wax), and if the mineral is fluorspar, the liberated HF will etch your name on the glass. Fluorspar, on account of its abundance, has but little commercial value. Its chief uses are, etching on glass, articles of virtu, and fluxing in smelting operations.—Ex-Blacksmith, Gorton Brook.

[illegible]—**Fluorspar.**—Fluorspar, fluoride of calcium, fluorite, blue john, amethystine, or topazine fluor, is a compound of calcium and fluorine CaF_2. It is found crystallised in large transparent cubes, white, pink, purple, and violet, in Saxony, Cumberland, and Derbyshire, and especially in the blue-john mine, Castleton, in the latter county. It is locally called blue john to distinguish it from black jack, a species of zinc ore. Ornamentally, it is used for turning vases, &c., the largest [illegible] vase in the world being in the Duke of Devonshire's sculpture gallery at Chatsworth. The Roman [illegible] of Pliny, are supposed to have been made from fluorspar. It is less valuable now than in former years, and I have read that some time ago it was worth £40 per ton "in the rough." It forms an excellent flux, hence its name, for metallurgical operations. When heated with sulphuric acid, or oil of vitriol, calcium sulphate and hydrofluoric acid are formed. This acid is used for etching on glass; but being highly corrosive and extremely dangerous, it must be kept in vessels of fluorspar, as it will corrode glass.—[illegible].

[illegible]—**Street Lighting.**—Sugg's, Bray's, Peebles', Borradaile's, and Thorp and Tasker's regulators for street lamps are all good. I would recommend the latter for ordinary lamps. For low-candle gas, use 4ft. and 5ft. regulators. For large lamps use Sugg's or Bray's triple burners with [illegible] service. For reflector use opal panes in lanterns.—W. T.

[illegible]—**Lantern Readings.**—The only way you can do what you want successfully is to take a lantern transparency of the bill, then show that; you may soak the bill in oil, or wax it, or mount it between two glasses with Canada balsam, but at the best it will cut a sorry figure on the screen.—W. J. Lancaster.

[illegible]—**Lantern Reading.**—It is easily done if you have a friend who is a photographer. Get him to take a photograph of your bill on a glass plate of such a size as will suit your lantern. This will be a negative; that is, the letters will be white on a black ground. If you don't object to that, then you can use this negative in your lantern. If you would prefer the lettering black on white ground, get your friend to print through this negative on to another glass plate, and the result will give you a picture for your lantern of the natural black letters on white ground, which I have supposed your bill to be.—Velvex.

[517[illegible].]—**Water Motors.**—Probably owing to to the pipe being throttled somewhere before it gets to the hose—perhaps at the tap, or connection with main.—Kanet.

[51719.]—**Water Motor.**—If the querist examines this, he will find that less water issues from his pipe when by contracting the opening he gets a force producing a jet 10 or 12ft. high. With the open end there is little or no pressure on the issuing water. The reason of all this is that no more water can flow than the supply permits. Now if the water has to flow through a long and small pipe, the pressure in the main is exhausted in driving it through, and if the opening at the end is of the full bore, the water simply runs out. If the opening is reduced so as not to allow free flow, a corresponding amount of pressure can be set up, which produces a jet.—Sigma.

[51721.]—**Sore Leg.**—For years I had two of the worst of bad legs. The following is my experience and cure. Rest, and keep the leg clean. Don't go to a doctor too much—he will charge you £10 for telling you to rest; don't drink beer, but a little whisky; and get twopennyworth of Goulard's extract, not diluted; put it in one quart of rain or soft water, it will then have the appearance of milk; wet linen cloths, and apply to the wound, to be changed as often as become warm or dry; when walking, or at work, put three or four thicknesses of linen on, and over this a bit of oiled silk and bandage, comfortably tight, and change at meal times if possible. The above will be, I hope, some use to J. Dexter, as it has cured bad legs of as long as twenty years' standing.—A Country Chip.

[51722.]—**Prevention of Rust in Firearms.**—Rangoon oil is the best for preserving the interior of rifles, &c., from rust. It does not lie on the surface of the metal only, but sinks in.—R. B. Hedley.

[51722.]—**Preventing Rust in Firearms.**—Fill with fresh lard *free from salt and moisture.* I have some now that were filled three years ago, and all right, although my house is rather damp. N.B. Make your own lard.—Kanet.

[51722.]—**Rust in Firearms.**—The best plan is to leave the barrel alone after firing, and the fouling will act as a protection against rust. It is, of course, necessary to take a "blow-off" shot before commencing to practice again. The lock may be cleaned with a little sweet-oil. I used to spend much time in cleaning my rifle after each evening's practice, but find the above method quite satisfactory, and much less trouble.—Wm. John Grey, Elswick Science School, Hon. Sec. Newcastle Rifle Association.

[51724.]—**Height of Barometer.**—·2618 must be added to the reading of "Norfolk's" aneroid. He must also allow for variation of temperature; but for all practical purposes $\frac{26}{100}$ will be near enough.—F. W.

[51724.]—**Height of Barometer.**—Supposing the height of the barometer in London is 30·00, reduced to mean sea level, and the thermometer attached to the barometer 60°, then if the thermometer on your aneroid stood at 60°, the finger on the dial should read 29·76.—M.M.I.Sc.S.

[51724.]—**Height of Barometer.**—From the following table you can easily reckon the difference—counting "0" as London:—

Feet 500	....	30·55 inches.
" 400	....	30·41 "
" 300	....	30·33 "
" 200	....	30·22 "
" 100	....	30·11 "
" 0	....	30·00 "

—Chemicus.

[51725.]—**Printing Potato Sacks.**—"Spuds" must either stencil or get the name and trade mark printed on with type or block at a jobbing printer's. Few care about the job, as it is a very dirty one.—Eccentric.

[51725.]—**Printing Potato Sacks.**—A very good way would be to have various alphabets made of plates of wood, made of nearly exact thickness and size, so that a number slipped or slid into a frame, would form the various words required; but instead of the letters being engraved on the wood plates, let them be bored through the wood as for brushes, and let bristles be drawn into the holes, in fact, let the hairs form the letters A B C, &c., &c. Having, by the single letters, brought together in the frame formed your wood, dip the frame face downwards in a trough containing the ink or paint, dab or press frame on the sack, and printing is done. If the trough is partly filled with coir fibre dust, and cloth spread evenly over it, the stamps would not take up too much ink or paint.—Hoinos.

[51729.]—**Electric Engine.**—Siemens' armature is not self-starting; it has a dead point. It can, however, be made to stop ready for starting by a catch in a disc fixed on the axis. A ring motor was described some time back which is self-starting, and will very likely suit you.—J. Sutcliffe.

[51735.]—**Boat.**—I cannot give sectional drawings; but if of service, shall be happy to give you measurements of 13ft. × 4ft. 6in. c.f., if you will specify what you require.—R. Hansen.

[51735.]—**Boat.**—If "Sir W. Waller" has the drawings of boat he wishes to build, drawn 1½in. to the foot, let him get a pantograph, and set it to enlarge 8 to 1, and the result will be a full-size drawing.—A Country Chip.

[51736.]—**Mechanics.**—I do not think the amplitude of vibration can be calculated from the data given. With regard to second question we have the well-known formula:—

$$f = \pi\sqrt{\frac{l}{g}}$$

$$f^2 = \frac{\pi^2 l}{g} \therefore l = \frac{f^2 g}{\pi^2}$$

using the approximate value $\frac{22}{7}$ for π, we get

$$l = \frac{2{\cdot}25 \times 32}{\left(\frac{22}{7}\right)^2} = \frac{2{\cdot}25 \times 32 \cdot 49}{484} = 7{\cdot}3\text{ft.}$$

—Wm. John Grey, Elswick Science School.

[51740.]—**Pills.**—To coat with sugar, you will require two or three soup plates and a covered earthenware pot. There are three operations:—

1. To moisten the pills.
2. To cover with chalk and sugar.
3. To finish by polishing.

To moisten the pills. Pour a good quantity of mucilage of tragacanth (made by dissolving 4gr. gum tragacanth in 1oz. of water) into one of the soup plates; turn it about so as to well cover the surface; drain, then introduce the pills, and shake about. Covering with chalk and sugar:—**Have a plate ready, with equal parts of French chalk and powdered loaf sugar spread over it, shoot the wet pills into it, and shake with a circular motion until fairly covered. Then put them into the pot, and shake with a jerking motion. Polishing. A jujube** tin answers very well for polishing. Sift the loose powder from the pills, and transfer to the tin, and shake briskly till dry. To silver, take a covered jar, same as used for coating with sugar, fill with mucilage, drain, and place pills in it, shake with a circular motion until pills are covered; then place with the pills some silver leaf (sold in books), and shake till covered.—CHEMICUS.

[51741.]—**Fixing Pipes to Harmonium.**—I should not advise "Chemicus" to apply pipes to his Alexandre harmonium, under the conditions he names. The varying pressure of air, proceeding from the ordinary pressure bellows, would cause the pipes to fluctuate in their pitch and tone, and for this reason the pipes would not always be in unison with the reeds. If the querist wishes to know how certain pipes are tuned, I will furnish the necessary information with pleasure; but I cannot, as a friend, recommend him to carry out such an idea as he proposes. I have had no experience with paper pipes, although I have heard that if they are properly made they produce a very clear and distinct kind of tone. Could not "Uranium" inform us how paper pipes are made? I think this information will be useful and interesting to a great number of our musical readers.—G. FRYER.

[51749.]—**Motor.**—The steel flanges will neutralise the magnetism in the armature; you had better replace them with brass ones.—J. SUTCLIFFE.

[51754.]—**Agriculture.**—As I happen to be a farmer, can answer "Estate Agent's" query, on a subject which probably the majority of our readers know nothing about. Appended is table:—

	Aver. val.		Aver. weight per acre.
	£	s.	Tons.
Mangolds	20	0	30 to 35
	6	0	
Turnips ..	4	10	20 to 25
Swedes	15	0	
	5	0	15 to 30
Carrots ..			10 to 15

The two values are for consuming price—i.e., roots eaten on ground, the other where they are drawn entirely off farm. The above figures must not be taken as correct, as no crop varies so much as the root crop in quality and value. Carrots are valued according as they are grown for stock or for garden stuff.—DERWOOD.

[51756.]—**Martini Henry Cartridges.**—These contain 85 grains of powder. I do not know what particular sort is used.—WM. JOHN GREY, Elswick Science School.

[51756.]—**Cartridges for Martini-Henry Rifle.**—I cannot tell T. H. Hall the name or maker of the powder used in the Government factory. In match shooting riflemen prefer to fill their own cases, especially if for use on long ranges, and invariably use Curtis and Harvey's A. W., or their No. 5 or 6, being the most reliable and suitable for rifle work. T. H. H. will require solid drawn brass shells, lubricating wads, a box of caps and bullets properly papered, ·450 gauge, 85 grains powder, weighed to a grain, a variation of even half a grain at the long ranges tells sensibly upon the work. The material mentioned may be obtained at any of the Birmingham houses in this trade, or from John Rigby, Dublin.—ECCENTRIC.

[51757.]—**Bradford's Washing Machinery.**—How *can* anyone answer "One in a Fix"? Why does he not write to the makers, who are the best of their kind? People buy second-hand machines and then declare they are useless, when it is their own stupidity and niggardliness that are in fault. In my experience no other maker's machines equal Bradford's, either for speed, cleanliness, or efficiency.—WASHERMAN.

[51759.]—**Escapements.**—To "R. E. B."—I cannot give you any reason why oil should not be applied to verge pallets, other than that oil would hold dirt and cause cutting. As regards the lever escapement, oil should not be applied unless you wish the fork and pin to cut and the watch to go badly. I have replied to "oiling watches," page 394, June 29.—R. E. B.

[51762.]—**Motor for Dynamo.**—Your dynamo can be worked direct by a quarter-horse turbine, but the cistern of 4ft. 2in. by 3ft. 3in. by 2ft. 8in. is too small to be of any use; it would not work it for five minutes. If you have not a large supply of water, get a small steam-engine and a half horse-power boiler.—J. SUTCLIFFE.

[51762.]—**Motor for Dynamo.**—If you regard the power of two men as equal to ¼ h.p., then as you have only a fall of 25ft., or a pressure of about 12lb. on square inch, for this pressure, to develop a power equal to that of two men, you would want a motor with cylinder 4in. diameter, and supply pipe 2¼in. diameter, the cost of which would be from £20 to £25. In your case I should recommend a gas or hot-air engine, as being less expensive in working.—DERWOOD.

[51765.]—**L. and N.W. Locos.**—In my last week's query, for "numbered 2527," read "numbered *above* 2527."—TITTESWORTH.

[51766.]—**Average Pressure.**—Multiply the weight by the distance through which it moves in feet, and divide by the area of piston, multiplied by feet traversed by piston per minute, and the product will give the average pressure necessary. Now, circumference of a pulley $1\frac{7}{8}$in. diameter $= 5\cdot89$in.; hence $(5\cdot89 \times 100) / 12 = 49$ft. $\times$ 5lb. $= 245$ ft.-lb. Then the traverse of piston $= (1\cdot875 \times 2 \times 100) / 12 = 31\cdot25$ft. $\times$ $1\cdot227$ area $= 38\cdot34375$; therefore, $245 / 38\cdot34375 = 6\frac{4}{16}$lb. per sq. in., the average pressure required. Now, as the radius of the crank is equal to the radius of the pulley, it follows that the weight divided by area of piston must give the pressure necessary to balance such weight: hence, 5lb. $/ 1\cdot227 = 4$lb. per sq. in., the required pressure.—ENGINEER, Dewsbury.

[51770.]—**Razor Paste.**—Mix equal parts of jeweller's rouge, blacklead, and suet.—THE KENT HERMIT.

[51770.]—**Razor Paste.**—Take a piece of coke and pound it very fine in a mortar, and then mix with sweet oil till it gets to a paste.—A. AND E.

[51774.]—**Mechanical Pianoforte.**—For the sake of brilliancy in the treble notes, I should have four strings, say $\frac{3}{16}$in. apart. Do not have the hammers wider than required, and cover them with rather hard felt. You can have two covered bass strings to each of the lower notes, which must vary in gauge accordingly. If a sketch is of any use to you, I will furnish an excellent plan, providing the Editor can spare the little amount of space necessary to describe it.—G. FRYER.

[51775.]—**Leclanche Battery.**—The ammonia is the product of the action, and as the battery is not meant for heavy work, there ought to be only a very faint smell. It is about the worst and most expensive battery one could use for electro-plating. The Smee is the best for inexperienced persons or for occasional use. The Daniell is best if there is any use for the reduced copper, or if it can be employed in the form of an electrotyping apparatus so as to produce objects as well as do the electrical work.—SIGMA.

[51775.]—**Leclanche Battery.**—"The smell of ammonia" referred to by this querist simply indicates that the battery is performing its functions. The zinc is attacked, dissolves, and forms a double chloride of zinc. The free ammonium (NH_4) is oxidised by the peroxide of manganese, and ammonia and water are formed. The binoxide is converted into the lower or sesquioxide Mn_2O_3. Before contact—

$$Zn,\ 2\,(NH_4Cl),\quad | \quad 2(MnO_2),\ C.$$

After contact—

$$ZnCl_2,\ 2NH_3,\ H_2O,\quad | \quad \overline{Mn_2O3,}\ C.$$

For simple electroplating the Daniell battery is decidedly superior to the Smee.—WALTER H. COLLINS.

[51776.]—**Electric Bells.**—Connect each of your pushes with the carbon pole of your battery, and also to the left-hand binding-screw of each of your bells; connect the right-hand screw of each bell to the zinc pole of your battery; then, if your bells are good ones, and your battery is good also, you will ring the five bells simultaneously by pressing either of the pushes. By regarding the thief alarm contact as an additional push, and connecting it with the system in the manner above described, it will act in the same way, and if you insert the switch in either of the wires proceeding from it at any point before reaching their junction with the main circuit, you will be able to "cut out" the alarm without interfering with anything else.—R. T. LEWIS.

[51778.]—**Steam Flour Mills.**—It depends a great deal on the size of stones and way in which they are dressed, and the quality of grain ground. A pair of 3ft. 9in., as I have now in use grinding barley into coarse flour, takes about 4½ h.p. to grind about 12qrs. in 10½ hours.—DERWOOD.

[51779.]—**Metallic Precipitates.**—This is rather a confusing question. Does querist want to know something which will precipitate all the metals, or different chemicals to precipitate each metal? Bronze is composed of copper, zinc, tin, and lead. Solution of hydric sulphide (sulphuretted hydrogen) would precipitate lead, copper, and tin: ammonium sulphide, hydrate, or carbonate, precipitates a solution of a zinc salt as sulphide, hydrate, or carbonate respectively. Ammonium carbonate, added to a solution of all these metals, would precipitate every one of them; so that if "An Experimenter" simply wishes to precipitate all the metals, and does not care what the resulting compounds are, this would be the easiest way.—R. A. R. BENNETT.

[41781.]—**Bichromate Battery Chemistry.**—The ruby crystals are chrome alum produced by the action. The greenish ones are, I think, only formed when the battery has been worked to exhaustion, or when much hydrogen has been given off. They are protosulphate of chromium, I think, but probably in combination with zinc sulphate. The others are zinc sulphate.—SIGMA.

[51781.]—**Chemical.**—The ruby-coloured crystals are those of chrome alum (K_2CrO_4, CrO_3); what the green ones may be I don't know at all. There is nothing in the ordinary bichromate solution which would form green crystals, unless it was sulphate of chromium, and it is scarcely likely to be that; probably impure sulphate of zinc. Dissolve some of the ruby crystals, and heat the solution to boiling; if it turns green, they are certainly crystals of chrome alum.—R. A. R. BENNETT.

[51782.]—**To Violinists.**—Proficiency in staccato bowing is the result of long patient study. It should be practised very slowly at first, and it is of the utmost importance that the bow does not leave the string during the playing of the whole passage. The notes are, as it were, cut out of the string by a sharp jerk of the bow, and the vibration of the string is immediately stopped by pressing the bow down. There is a bastard kind of staccato which is produced by the elasticity of the bow, which bounds from the string between each note. To produce a clear, pearly staccato, the bow must be a good one, neither too weak nor too strong. It must be light and elastic, but stiff withal. Such bows are valuable, and when found should be cherished. I advise your correspondent to procure a bow made by a good maker, for which he will have to pay something over a guinea. If he cannot then play staccato music, the fault lies not in the bow but in him who boweth.—THOS. LISLE.

[51784.]—**Electric Tricycle.**—This is a very interesting subject. I suppose the chief practical impediment to the attainment of this object in an independent machine is the weight of the accumulator, and the impossibility of generating by any known battery a force sufficient for reasonable propulsion. We cannot create force, but must derive it from some source. Could not the force of the human body be utilised to turn something which might set an electro-magnet revolving, and so develop a current of the requisite amount of power? I write as a tyro, and under all due correction.—W. B. M.

[51784.]—**Electric Tricycle.**—I fancy "Apprentice" will have a great lot of bother in trying to make his tricycle run by means of electromotive power, even if he follows the method adopted by Messrs. Ayrton and Perry. I don't know anything about the copper oxide battery; it probably does not give so much E.M.F. as the single fluid bichromate, and I base my calculations from all use of this. The "Griscom" motor of the size now sold would not be of the slightest use. This little motor (according to prospectus now before me) gives with 6 gallon bichromate cells 1,000ft.-pounds, and as a force equal to 5,000ft.-pounds would be required to move a tricycle on the level, 30 of these cells would require to give power wanted (this is only approximate); in theory, not so many would be wanted. The cells would have to be sealed to prevent solution spilling, and the weight of these batteries (30) being something like 3cwt. in addition to weight of rider and machine itself, I think "Apprentice" will see that as yet the propulsion of tricycles by means of electricity (derived from batteries) is not practicable, at least, that is the impression of—DERWOOD.

[51785.]—**Electric Telltales.**—If "E. C." will send for J. T. Gent and Co.'s (of Leicester) book on "Electric Bells" I think he will get the required information.—H. G. E.

[51785.]—**Electric Tell-Tales.**—A most ingenious system is Hancock and Yeates' patent electric tell-tale clock, which I saw working for a time at the Mountjoy Female Convict Prison, Dublin, and I believe gave satisfaction. The watchman has to touch a press-button fixed in each room or place at certain times, which is recorded on a drum attached to the clock, which can be placed in the master's room any distance away. If the button is not pressed at the right time, an alarm rings; or if the wires are cut, or the button plugged in, the alarm will also ring. In fact, the only way to keep the alarm from sounding is for the watchman to press the button at the right time, and in a certain order, which can be altered for different places in the electrical gear in the clock part. Any number of stations may be put on in this system. Each station, when the button is pressed, is recorded on the drum at the exact time of pressing, so in the morning a complete record of where the watchman has been during the night can be seen. I don't know what the cost of the whole apparatus is. The patent is "Hancock and Yeates' Watchman's Electric Tell-tale and Fire-Alarm, No. 1,598, April 24, 1877." Messrs. Frengley Bros., Crow-street, Dublin, have bought the patent, and, I believe, supply the clocks. If "E. C." would write to them I am sure he could get full particulars of cost, &c.—IOLANTHE.

[51786.]—**Water-Way.**—The lowering of the head end. They were quite transparent, and one could see easily, with a 1½in. objective, the heart's (?) action on a long irregular-shaped mass of red fluid. They were exceedingly lively, and seemed to have shed their skins—as there were traces about of their membrane resembling the contour of the animals. There was also present the dead and flattened body of a species of small spider about 1-25in. diam.; but this might have been an accidental spider egg introduced to the box at the same time as the other eggs.—P. WARD.

[51829.]—**Chimney.**—I have a house three stories high: rooms about 6 or 7ft. The under room has a chimney to it. I want to put one to the next room. Can I carry it into the under one, so as not to interfere with the draught? Will some kind brother tell me the best way? This is to be a kitchen. I should therefore be glad of size of fireplace and chimney for small cottage oven grate, and the best sort of the latter.—CHIMNEY.

[51830.]—**Photographic.**—I am terribly bothered in trying to get effectually rid of our friend "hypo.," both in washing my negatives and prints, water being a very scarce commodity with me, as all the water I use for photographic purposes has to be fetched in buckets a distance of about 100 yards, and then siphoned out of a bucket which acts as a cistern for washing negatives, &c. Can "A. T. P.," or any of "ours," give me the benefit of their experience, and assist me in this matter? The labour is indeed very great, and if it were not that I take a great interest in the seductive art, I should have given it up before this. Are there any means of getting rid of hyposulphite of soda without a copious use of water, and without damaging the negative or print? A word or two on this subject will be gratefully received.—AMATEUR TYRO.

[51831.]—**Electric Gas Lighter.**—Can any reader of ours inform me of the constituent parts and action of the battery of this apparatus? Also how to recharge when necessary without sending to the makers.—VANDU.

[51832.]—**Damp Shop.**—I have a shop which, when I open in the morning, has a very bad smell, caused by dampness. The landlord has done all that I can get him to do, but has not improved it much. As I am obliged to be in the shop nearly all day, I wish to know what I could use to keep the sickening odour away, which is very objectionable to customers on first entering. I am sitting nearly all day, so cannot always have the door open, except it is very warm. Any suggestions would oblige.—SHOPKEEPER.

[51833.]—**Draught Screen for Drawing-Room.**—Wanted instructions how to cover with canvas and paper, and to prepare the surface for glueing or pasting on pictures.—NEMO.

[51834.]—**Soap and Soda.**—Given a mixture of soap and soda in powder. Can any fellow reader state a simple method of estimating the quantities of each?—A. SMITH.

[51835.]—**Contact Breaker.**—Will some of our electrical friends kindly suggest a plan for contract breaker that will answer following requirements? Have made a model to work by electro-magnet and armature, and it works well when I make and break contact myself. The armature is arranged as in an electric bell and retains its normal position by its own weight, drawing some levers to work the model; but if the breaker is made as an electric bell the armature works too rapidly, and I want one that will work slowly, pulling the armature about from ¼ to ½in. How may it be accomplished?—KIKO.

[51836.]—**Alkaloid of Iron.**—Perhaps some of your readers can inform me of an inexpensive process by which I can make small quantities of an aqueous solution of iron or iron and sodium, or the name of a textbook in which the process is detailed, as it is not given in the one I have?—J. McINTOSH.

[51837.]—**Compressed and Liquefied Gases.**—Can any subscriber give me answers to the following queries? Any information will be thankfully received. Whether atmospheric air can be liquefied, and if not, to what extent compressed. Please state the gases that can be liquefied and those that can only be compressed. I should also feel obliged if any one could inform me whether there is a book published on the subject and where it can be obtained. I am aware most books on chemistry treat on the subject.—R. W.

[51838.]—**Size of Flywheel, &c.**—Would some of our readers kindly me what is the rule for the size of flywheel with regard to size of cylinder? I have two cylinders, each 1½in. bore and 4in. stroke, and intend working them at, say, 10lb. pressure. What weight and what diameter of flywheel should I have?—G.

[51839.]—**Chemical.**—What is the best process for finding the exact percentage of morphia in opium? A prompt and detailed answer will much oblige.—L. B.

[51840.]—**Nickel Plating.**—Will any of your readers inform me why, during the above process, the article being plated is sometimes covered with cloudy spots or smears presenting a mottled appearance and which easily wipes or brushes off, exposing the metal underneath. The salts I use have been in use for about 9 months with additions now and then. Sometimes the articles come out nice and bright with the the nickel firmly adhering. At other times it comes as above. Are the salts deteriorated by use? If two batteries are used for greater power, should the corresponding wires from both batteries be attached to the respective rods over the vat by the same connection? I use a vat with 10 or 12 gallons of salts, and what is known as an American battery, sometimes two.—ALPHA.

[51841.]—**To Mr. Wetherfield.**—A brother of mine died nine years back at the Cape of Good Hope. I want to find out whether or not he made a will. I know no one there who can or will give me the information. Can you put me in the way to find out, and if he made a will, how shall I get a copy of it? If no will has been proved, and no one has administered to property he possessed, what would you advise me to do? I am his eldest brother. My brother was a widower, and had no children when he died. He was possessed of leasehold houses in London (England). No will of his has been proved at Somerset House, and letters of administration have not been granted. Can I now administer to his estate in London?—A BAFFLED ONE.

[51842.]—**Colouring Wax Dolls.**—Will some one inform me how wax dolls may be recoloured? They have been somewhat exposed to the sun, and have become very pale.—T. W. P.

[51843.]—**American Railways.**—Can any reader give a short statement of the mileage and routes of the principal American Railways, with a few particulars as to their financial position? I see the completion of the Northern Pacific has been followed almost immediately by a rapid fall in the price of its shares. Why is it that American railway shares fluctuate so? I have noticed recently that several descriptions have receded as much as 50dol. in a few months. Denver and Rio Grande shares, for instance. Is this line a new one, and are the fluctuations in its shares merely stock exchange fluctuations, or has it gone to the bad in such a decided way as to cause the decline?—S. J.

[51844.]—**Transmitter.**—Would any correspondent kindly tell me the form of transmitter used by the telephone company in Coleman-street, and how the connections are made for transmitter, coil, bell, and telephone? Is there any recent book fully illustrated?—C. L.

[51845.]—**Photographic Studio.**—Would some reader kindly instruct me in this? I am thinking of building a studio something like the following: 20ft. long, 10ft. wide, 7ft. high in the square, pitched roof, one side 4ft., sash 16ft. long, facing north. How and where should I have the top light? I thought about 6ft. light in the centre, side facing north; but I am afraid the light would fall all on one side of sitter. Please give me plain instructions, and oblige.—M. R.

[51846.]—**Hyposulphite of Soda.**—After fixing a batch of prints, I have thrown above away—3oz. to one pint. Would same do for clearing dry plates after developing?—M. R.

[51847.]—**Small Dynamo.**—Would one of these that will light a couple of lamps do to drive an induction coil that gives a good thick inch spark?—M. R.

[51848.]—**Lost Watch Wheel.**—To "ALFOJOR."—Will you please give the method to determine the number of teeth and leaves in a wheel and pinion—say fourth wheel—which has to be replaced by a new one?—HALL.

[51849.]—**Commutator.**—Would "Sigma" please say how I can arrange the commutator of a Siemens' armature so as to get a positive and a negative current always in the same direction, same as from a Gramme machine, and oblige?—WIRE.

[51850.]—**Canoe, or Small Sail Boat.**—To "BAIL OUT."—Having been told of a plan to get rid of water, either leakage or that taken over the side, I write to know if any of "ours" know of its practical working—viz., to have a pipe projecting through bottom of boat with end bent towards the stern of boat, and that when an inside plug is withdrawn (or a tap turned) whilst the boat is travelling at a good speed, that the water will be run out of the boat by the suction of the passing water. Information will much oblige; for if this plan will act, it would suit my case admirably. Speed attainable up to nine miles an hour. Both pump and bailing, now in use, are troublesome and tedious—especially when under way.—CÆSAR.

[51851.]—**Chemical.**—Will some kind reader tell me if the following mixture is chemically combined?—9 parts $KClO_3$, 2 parts $C_{12}H_{11}O_{11}$, 1 part $K_4FeC_6N_6$, with C52·9H7·0N17·1O22·9. Also if there is any danger in compressing the mixture by hydraulic pressure?—NOVICE.

[51852.]—**Gazogenes.**—Will any reader kindly explain the construction of the metal heads of these aërated-water machines, and state whether they can be taken to pieces for repair? I have had mine two or three years, and it is by the best makers (Gerault and Co.), but for some time past, whenever it is charged, there is an escape of air, which renders the water quite flat. Thinking it might be at the junction with the glass, I carefully cemented it; but the escape still continues, and is evidently inside the head. It has been to the maker's once, but without success, and their repairs are somewhat costly?—BETA.

[51853.]—**Electric Lighting.**—What advantage is gained by joining incandescent lights in series of equal numbers? I can see a slight saving of wire in running the circuits; but apart from this I fail to see any gain—unless it is lowering the resistance of the circuit, which I don't quite see. And why should series have to be equal in number of lamps, when they are actually all on the same circuit, as only two wires lead from dynamo? This question has puzzled a good many like myself. Will any electrical reader kindly give the desired information in as clear a manner as possible.—VEBER.

[51854.]—**Legal.**—Would Mr. Wetherfield answer the following?—I sold my business some time ago, and I signed a covenant to this effect (Extracts from deed):—"Will not, during the continuance of the said term of 21 years, carry on or be engaged in the trade or business of a hot-water engineer, gasfitter, &c." The question is this: I have invented several things. One thing is an apparatus for heating offices, &c." I want to know whether the party that bought my concern can prevent me from manufacturing them for wholesale or otherwise. I am now living about 310 yards from the business that I sold.—ONE IN A FOG.

[51855.]—**Telescopic.**—I have a small terrestrial telescope by Dolland. Could it be used for observing sunspots, &c.? If so, how could I darken it, &c., for that purpose?—WARRAGUL.

[51856.]—**Ozone Papers.**—Kindly inform me how to make ozone paper to purify the atmosphere of a room after dinner, and at other times. Also what kind of bibulous paper is best suited for the purpose?—H. GEORGE.

[51857.]—**Mushroom Bed.**—Will any one please to tell me a way to grow mushrooms artificially, and the right time of the year to plant the spawn?—G. T. DENYER.

[51858.]—**L. & S.W.R. Locomotives.**—Would "W. B. P." kindly favour me with the dimensions of bogie engine, No. 136?—F. W. BREWER.

[51859.]—**Fairy Bells.**—Will Mr. G. Fryer or any reader kindly inform me how to make, with dimensions of same?—J. W. L.

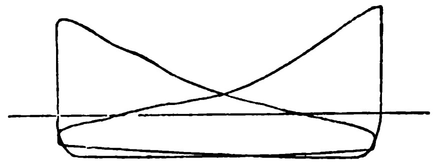
[51860.]—**Roller versus Stone Milling.**—Can any of ours kindly give me their experience of the above, or suggest any improvement on my present mode. I am now operating five pairs of stones on the half-high grinding system, making about fifty per cent. middlings, but cleaning my brass with the burrs. The middlings are graded into two series, purified and rolled separately. I take off about 10 per cent. of patent, which is very good indeed, but my customers are asking for a much larger supply of this than I can at present make. I now propose to increase my make of patent flour by putting in the best form of first break machine I can procure, aspirating the product, and scalping to take out the crease dirt. Then, by a second reduction on stone grinding, very high, make my middlings. Scalp these to take out germ and the coarsest middlings, these and the bran going to separate rolls, the remainder of the chop to a dusting reel. The middlings from this would be graded and purified, the coarsest going to rolls, the finest to stones. Some of ours may be working on this system, and can inform me what quantity of patent I could safely take off, and whether it would be of equal quality to that I now take from my rolls. I have seen some splendid work on the first break done by disc mills, and am led to think that the superiority of this over the first break by rollers will place my manufacture on a level with an entire gradual reduction system, for which I have not room.—DUSTY.

[51861.]—**Earth's Path about Moon.**—Would "F.R.A.S." kindly say the exact distances of the earth and the moon from common centre of revolution of their orbits about each other?—P.

[51862.]—**Radiant Heat into Light.**—Is there any known instance of radiant heat being converted into or affording light when no combustion in the ordinary sense takes place?—P.

[51863.]—**Arranging Brass Band Music.**—I wish to arrange some glees, anthems, and four-part songs for a brass band of 24 performers. Would any of our musical friends kindly inform me which are the most suitable instruments for the particular vocal parts? Any hints on the subject would oblige.—EUPHONIUM.

[51864.]—**Indicator Diagrams.**—The following diagrams are taken from a horizontal condensing engine. Cylinder, 30¼in. diam.; 4ft. stroke, running at 40 revs. per minute. Boiler pressure, 40lbs. Vacuum according to guage glass on condenser, 12¾lb. Scale of diagrams, 24lb. to one inch. The slide has iron cut-off valves set at time of indicating to cut off at ⅜ stroke. The main valve has ¼in. lead and 1in. outside lap. How can I set these valves to get nearer boiler pressure (there being only about 15ft. of 6in. steam pipe between engine and boiler), and more vacuum? Foot and head valves and air-pump bucket in good order.—P.A.D.



[51865.]—**Scientific Lending Library.**—Is there any place where scientific books can be had at a moderate subscription? If not, would it not pay well to get one up; or is there any place where they can be read besides the British Museum?—F. W.

[51866.]—**Dark Slide.**—When Mr. Lancaster gives this much-desired information, will he also give an opinion on, and instruction for making, the changing box, lately described in No 961. of the "E.M." Would it not be useful if it only contained seven instead of thirteen plates? It would not be such a heavy back weight on the camera.—F. W.

[51867.]—**Bicycle Wheel.**—Would any of our readers kindly inform me the best way to centre a new wheel? Also the best way to put on rubber tires?—J. H. H.

[51868.]—**Telescope.**—To MR. LANCASTER AND OTHERS.—I have in my possession an achromatic telescope for terrestrial purposes, with a 2¼in. object-glass, and 46in. focal length, warranted best make, by A. Franks, Manchester. Could you inform me what amount of magnifying power I might expect of it at present, and what is the highest possible power of an astronomical eyepiece that could be adjusted to its present make, and also its cost?—ASTRO.

[51869.]—**Ozone.**—I should be glad if you, or some of your readers, could give the generally accepted theory of formation of ozone when a stick of phosphorus is placed in a jar of moist air (Roscoe "Elem. Chem.," page 15). If someone would kindly give results of any investigations which have been made on the subject, I should be greatly obliged.—OZONE.

[51870.]—**Poor Law.**—To MR. WETHERFIELD.—Will he oblige by answering the following?—A man and his wife and two children—one aged nine, the other 16—had to part; she goes into the union. He is summoned before a magistrate, and an order made on him for 12s. per week for her support and the children. She now has come into property. Is the man now bound to pay her 12s. per week still, or can the guardians force him, if she goes into the union, she not now being destitute?—LAW.

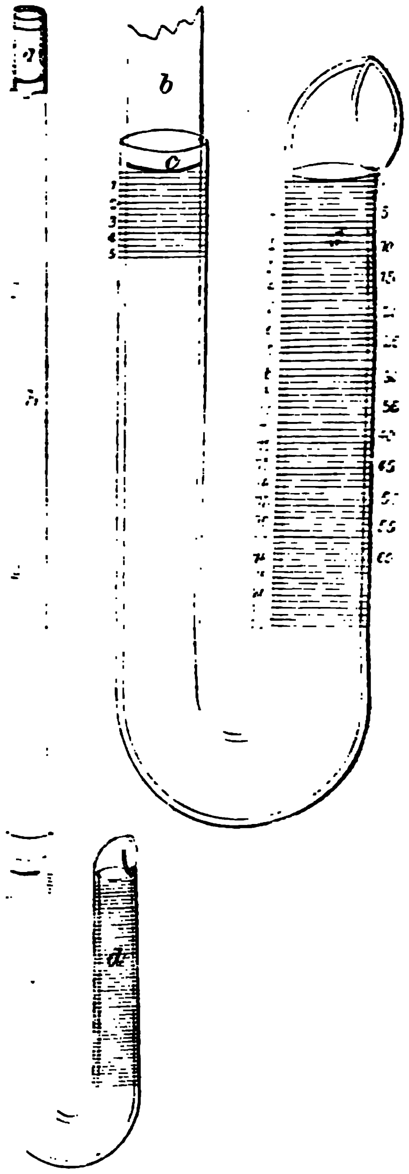
[51871.]—**Keel for Model.**—Can any correspondent inform me as to the best way of casting lead keel on to the false keel of a working 2ft. 6in. model of a yawl? I have seen them on the boats, and you are unable to see any heads of screws through the bottom of keel.—MODEL SAILOR.

[illegible]

[illegible] with a [illegible] water displaced [illegible] filling it [illegible] marking *this* [illegible] commencing from [illegible] 22 is the specific [illegible] "Deschanel," p. 86. [illegible] the box *a* filled with [illegible] marks the point of its displacement [illegible] this is the specific gravity [illegible] space between these two last [illegible] course, to be graduated 2·4 "degrees," [illegible] this will give the dimensions of the [illegible] the rest of the tube upwards. The [illegible] the box *a* is determined by the con[illegible] to the maker of the point 22. If he [illegible] 22 to be *very* low down on the tube, *a* must be a long box, and *vice versâ*. Of course, if [illegible] necessary, the box can be withdrawn by a silk thread attached to the top.

[illegible] may be objected that this method does not [illegible] actual displacement of water, inasmuch as the substance does not take the place of the water—i.e., is not actually immersed in it; but that does not matter to the operator, as long as the correctness of his scale of specific weights is [illegible] (as it, of course, will be here) by two [illegible] pure substances—Platinum and Gold—and the displacement points of these two ought

Fig. 1 Fig. 2.



REFERENCES TO FIGS. 1 AND 2.

(Scale, 1·5in. to the foot.)

a, a small brass box filled with the fine sand of the substance the specific gravity of which is to be determined. The outer diameter of this box must be as near as possible to the inner diameter of the tube *b*, but the box must pass down the latter without obstruction.

b, a brass or copper tube, supposed to require to be about 3ft. long, down which, standing perpendicularly, the box *a* filled with the mineral sand, is to be dropped.

c, a little oil covered by a pasteboard or wooden disc or wad, to receive the first impact of the sand-laden box *a*.

d, a strong U-bent glass tube, filled with rain or distilled water, covered in its left leg with oil (*c*), and graduated outside its right leg with a scale (determined by the box *a*, full of platinum filings or sand), showing the amount of water displaced by the fall of the box (*a*). The right leg is covered by the slightly bent tube to prevent any water spirting up and dropping back into the tube.

The left leg of the tube may be graduated at *c* in order to measure the first violence or energy of impact.

not to be marked except as the result of many careful experiments.

At all events, such an instrument as the above described may surely claim at least equal correctness with the method detailed by Professor Cornwall, "Determinative Mineralogy," 1882, page 252, Fig. 69, in which, apparently, an ordinary butcher's spring "scales" is used (!) in which the list of degrees is "engraved on a mirror, so that the index and its reflected image to light during the systematic investigation, as reported on by Dr. Falconer, of the Brixham Cave, must, I think, have prepared you to admit that scepticism in regard to the cave evidence in favour of the antiquity of man had previously been stretched to an extreme (*Report. Brit. Assoc. 1858, Trans. Sect., p. 95*).

It is probably unnecessary to quote further to show how very large a share the exploration at Brixham had in impressing the scientific world generally with the value and importance of the geological evidence of man's antiquity. That impression, begun as we have seen in 1858, has not only lasted to the present day, but has probably not yet culminated.

Few, it may be presumed, can now doubt that those who before 1858 believed that our fathers had under-estimated human antiquity, and fought for their belief, have at length obtained a victory. Nevertheless, every anthropologist has doubtless from time to time

"Heard the distant and random gun
That the foe was sullenly firing."

The "foe," to speak metaphorically, seems to consist of very irregular forces, occasionally unfair, but never dangerous, sometimes very amusing, and frequently but badly armed or without any real armour. The Spartan law which fined a citizen heavily for going into battle unarmed was probably a very wise one.

For example, and dropping a metaphor, a pamphlet published in 1877 contains the following passage:—"With regard to all these supposed flint implements and spear and arrow heads found in various places, it may be well to mention here the frank confession of Dr Carpenter. He has told us from the presidential chair of the Royal Academy that, 'No logical proof can be adduced that the peculiar shape of these flints were given them by human hands.'" The words ascribed to Dr. Carpenter are put within inverted commas, and are the whole of the quotation from him. I was a good deal mystified on first reading them, for while it seemed likely that the president spoken of was the well known member of this Association—Dr. W. B. Carpenter—it was difficult to account for his being in the presidential chair of the Royal Academy, and not easy to understand what the Royal Academy had to do with flint implements. A little search, however, showed that the address which Dr. W. B. Carpenter delivered in 1872 from the presidential chair of, not the Royal Academy, but the British Association, contained the actual words quoted, followed immediately by others which the author of the pamphlet found it inconvenient to include in his quotation. Dr. Carpenter, speaking of "common sense," referred by way of illustration, to the "flint implements," of the Abbeville and Amiens gravel beds, and remarked, "No logical proof can be adduced that the peculiar shapes of these flints were given to them by human hands; but does any unprejudiced person now doubt it?" (*Report Brit. Assoc.* 1872, p lxxv.). Dr. Carpenter, after some further remarks on the "flint implements" concluded his paragraph respecting them with the following words: "Thus what was in the first instance a matter of discussion, has now become one of those 'self-evident' propositions which claim the unhesitating assent of all whose opinion on the subject is entitled to the least weight."

It cannot be doubted that, taken in its entirety, that is to say, taken as every lover of truth and fairness should and would take it, Dr. Carpenter's paragraph would produce on the mind of the reader a very different effect to that likely, and no doubt intended, to be produced by the mutilated version of it given in the pamphlet.

A second edition of the pamphlet has been given to the world. Dr. Carpenter is still in the presidential chair of the Royal Academy, and the quotation from his address is as conveniently short as before.

It would be as easy to bring together a large number of similar modes of "defending the cause of truth"—to use the words of the pamphlet just quoted—but space and time forbid.

Mr. Pengelly did, however, give some other instances of extraordinary perversions of fact, and then proceeded with his history. As already intimated, the result of the researches at Brixham quickened a desire to re-examine the Kent's Cavern evidence, and this received a considerable stimulus from the publication of Sir C. Lyell's "Antiquity of Man" in 1863.

Early in 1864 I suggested to Sir C. Lyell that an application should be made to the British Association, during the meeting to be held at Bath that year, for the appointment of a Committee, with a grant of money, to make an exploration of Kent's Cavern, and it was decided that I should take the necessary steps in the matter. [This Committee was appointed and a grant made by the Association.] The mode of exploration was essentially the same as that followed at Windmill Hill, Brixham, but as Kent's Cavern, instead of being a series of narrow galleries, contained a considerable number of spacious chambers, and as the aim of the exploration was to ascertain not merely what objects the deposits contained, but their exact position, their distribution, their condition, their collocation, and their relative abundance, the details had to be considerably more elaborate, while they remained so perfectly simple that the workmen had not the least difficulty in carrying them out under my daily superintendence.

Mr. Godwin-Austen, while agreeing with Mr. MacEnery that flint implements occurred under the stalagmite, contended that they were found throughout the entire thickness of the cave earth. MacEnery, on the other hand, was of opinion that in most cases their situation was intermediate between the bottom of the stalagmite and the upper surface of the cave earth; and while admitting that occasionally, though rarely, they had been met with somewhat lower, he stated that the greatest depth to which he had been able to trace them was not more than a few inches below the surface of the cave earth (*Trans. Devon. Assoc.* iii. 325-327). The Committee soon found themselves in a position to confirm Mr. Godwin-Austen's statement, and to say with him that "no distinction founded on condition, distribution, or relative position can be observed whereby the human can be separated from the other reliquiæ" (*Trans. Geol. Soc.* 2nd ser. vi. 444). Mr. MacEnery's "Plate F" contains seven figures of three remarkable canine teeth, which in 1846 Prof. Owen assigned to *Machairodus latidens*. A considerable amount of scepticism existed for many years in some minds as to whether the relics were really found in Kent's Cavern, it being contended that from its zoological affinities *Machairodus latidens* must have belonged to an earlier fauna than that represented by the ordinary cave mammals; but there is no longer any doubt of MacEnery's accuracy; no doubt that *Machairodus latidens* is a member of the cave earth fauna, whatever the zoological affinities may say to the contrary; nor is there any doubt that man and *Machairodus* were contemporaries in Devonshire.

When their exploration began, and for some time after, the Committee had no reason to believe or to suspect that the cavern contained anything older than the cave earth; but at the end of five months, facts, pointing apparently to earlier deposits, began to present themselves; and at intervals more or less protracted, additional phenomena, requiring apparently the same interpretation, were observed and recorded; but it was not until the end of three full years that a vertical section was cut, showing, in undisturbed and clear succession, not only the cave earth with the granular stalagmite lying on it, but, under and supporting the cave earth, another, thicker, and continuous sheet of stalagmite—appropriately termed crystalline—and below this again an older detrital accumulation, known as the breccia, made up of materials utterly unlike those of the cave earth.

The breccia was just as rich as the cave earth in osseous remains; but the lists of species represented by the two deposits were very different. It will be sufficient to state here that, while remains of the hyæna prevailed numerically very far above those of any other mammal in the cave earth, and while his presence there was also attested by his teeth-marks on a vast number of bones, by lower jaws—including those of his own kith and kin—of which he had eaten off the lower borders as well as the condyles, by long bones broken obliquely just as hyænas of the present day break them, and by surprising quantities of his coprolites, there was not a single indication of any kind of his presence in the breccia, where the crowd of bones and teeth belonged almost entirely to bears.

No trace of the existence of man was found in the breccia until March, 1869, that is about twelve months after the discovery of the deposit itself, when a flint flake was met with in the third foot-level, and was believed to be not only a tool, but to bear evidence of having been used as such. Two massive flint implements were discovered in the same deposit in May, 1872, and at various subsequent times other tools were found, until at the close of the exploration the breccia had yielded upwards of seventy implements of flint and chert.

While all the stone tools of both the cave earth and the breccia were Palæolithic and were found inosculating with remains of extinct mammals, a mere inspection shows that they belong to two distinct categories. Those found in the breccia—that is, the more ancient series—were formed by chipping a flint nodule or pebble into a tool, while those from the cave earth—the less ancient series—were fashioned by first detaching a suitable flake from the nodule or pebble, and then trimming the flake—not the nodule—into a tool.

It is worthy of remark that in one part of the cavern, upwards of 130 feet in length, the excavation was carried to a depth of nine feet, instead of the usual four feet, below the bottom of the stalagmite; and that, while no bone of any kind occurred in the breccia below the seventh foot-level, three fine flint nodule tools were found in the eighth, and several flint chips in the ninth, or lowest foot-level.

It may be added that the same fact presented itself in the lowest or corresponding bed in Brixham Windmill Hill Cavern. In short, in each of the two famous Devonshire caverns the archæological zone reached a lower level than the palæontological.

That the breccia is of higher antiquity than the cave earth is proved by the unquestionable evidence of clear undisturbed superposition: that they represent two distinct chapters and eras in the cavern history is shown by the decided dissimilarity of the materials composing them, the marked difference in the osseous remains they contained, and the strongly contrasted characters of the stone implements they yielded; and that they were separated by a wide interval of time may be safely inferred from the thickness of the bed of stalagmite between them.

It is probable, however, that the fact most significant of time and physical change is the presence of the hyæna in the cave earth, or less ancient, but not in the breccia, or more ancient, of the two deposits. Bearing in mind the cave-haunting habits of the hyæna, the great preponderance of his remains in the cave earth, and their absence in the breccia, it seems impossible to avoid the conclusion that he was not an occupant of Britain during the earlier period.

The acceptance of this conclusion, however, necessitates the belief (1) that man was resident in Britain long before the hyæna was. (2) That it was possible for the hyæna to reach Britain between the deposition of the breccia and the deposition of the cave earth. In other words, that Britain was a part of the Continent during this interval.

Sir C. Lyell, it will be remembered, recognised the following geographical changes within the British area between the Newer Pliocene and historical times (see "Antiquity of Man," edition 1873, pp. 331, 332). Firstly, a pre-Glacial Continental period, towards the close of which the Forest of Cromer flourished, and the climate was somewhat milder than at present. Secondly, a period of submergence, when the land north of the Thames and Bristol Channel, and that of Ireland, was reduced to an archipelago. This was a part of the Glacial age, and icebergs floated in our waters. Thirdly, a second Continental period, when there were glaciers in the higher mountains of Scotland and Wales. Fourthly, the breaking up of the land through submergence, and a gradual change of temperature, resulting in the present geographical and climatical conditions.

It is obvious that if, as I venture to think, the Kent's cavern breccia was deposited during the first Continental period, the list of mammalian remains found in it should not clash with the list of such remains from the Forest of Cromer, which flourished at that time. I called attention to these lists in 1874, pointing out that according to Prof. Boyd Dawkins (Cave-Hunting," p. 418) the forest bed had at that time yielded twenty-six species of mammals, sixteen of them being extinct and ten recent: that both the breccia and the forest bed had yielded remains of the cave-bear, but that in neither of them had any relic or trace of hyæna been found. A monograph on the "Vertebrata of the Forest Bed Series" was published in 1882 by Mr. E. T. Newton, F.G.S., who, including many additional species found somewhat recently, but eliminating all those about which there was any uncertainty, said: "We still have forty-nine species left, of which thirty are still living, and nineteen extinct" (p. 135). Though the number of the species has thus been almost doubled, and the presence of the cave-bear remains undoubted, it continues to be the fact that no trace of the hyæna has been found in the forest bed, and no suspicion exists as to his probable presence amongst the eliminated uncertain species. It should be added that no relic or indication of hyæna was met with in the "Fourth Bed" of Brixham Windmill Hill cavern, believed to be the equivalent of the Kent's Hole breccia. I am not unmindful of the fact that my evidence is negative only, and that raising a structure on it may be building on a sandy foundation. Nevertheless, it appears to me, as it did ten years ago, strong enough to bear the following inferences:—1. That the hyæna did reach Britain until its last Continental period. 2. That the men who made the Palæolithic nodule-tools found in the oldest known deposit in Kent's Cavern arrived during the previous great submergence, or, what is more probable—indeed, what alone seems possible unless they were navigators—during the first Continental period. In short, I have little or do doubt that the earliest Devonians we have sighted were either of Glacial or, more probably of pre-Glacial age. It cannot be necessary to add that while the discovery of remains of hyæna in the forest bed of Cromer, or any other contemporary deposit, would be utterly fatal to my argument, it would leave intact all other evidence in support of the doctrine of British Glacial or pre-Glacial man. Some of my friends accepted the foregoing inferences in 1873, while others, whose judgment I value, declined them. Since that date no adverse fact or thought has presented itself to me; but through the researches and discoveries of others in comparatively distant parts of our island, and especially in East Anglia, the belief in British pre-Glacial man appears to have risen above the stage of ridicule, polis last year exceeded two and a quarter millions sterling, equal to 1s. 6d. in the pound on the present annual rateable value of property; and that of this sum, probably, at least one million would have been saved by a system of hydrants with an adequate water supply, such as those which have existed for many years in Liverpool, Manchester, and Glasgow. The water supply of London, however, although satisfactory as to quantity, has not sufficient pressure for hydrant purposes, and from the fact that the supply has to be pumped up from a low level, instead of coming by gravitation from high sources — as in the towns referred to—it is impossible, without enormous expenditure, to adapt it for hydrants. Sir William Armstrong's accumulator system of hydraulic power, generally in use at the docks and goods termini, requires no description. In connection with the injector hydrant it has been found to be specially applicable to the production of jets of water for fire extinction in cases where the ordinary supply has not sufficient pressure for the purpose. Applied to the metropolis generally in the same way it would funish a complete and efficient system of fire hydrants, without imposing upon the ratepayers any additional burden; and if the hydraulic power were applied to commercial purposes there would result a considerable gain to them.

On the Magnetisation of Iron and Steel.

Sir William Thomson then read a communication "On the Magnetic Susceptibility and Retentiveness of Iron and Steel" from Mr. J. E. Ewing. The author said that he had been experimenting in Japan on the effect of stress in relation to magnetisation, and he had demonstrated the hitherto unsuspected fact that soft iron is capable of an immensely greater degree of magnetisation than steel. The method employed was to subject wires to the magnetising force, tapping them during its application and withdrawing it gradually. When this plan was followed 93 per cent. of the charge remained. He had obtained magnetic intensity of 1,590 units, while Thalen only obtained 40 from soft Swedish iron, and Roland 200. This result, Sir William Thomson said, was a satire on our knowledge of magnetism. The author also stated he had computed the heating effect of the reversal of the induction in iron in absolute measure.

Electrical Standards.

Mr. R. T. Glazebrook read the report of the Committee on Electrical Standards, which explained that the original B. A. units had been compared between themselves, and the mean had been taken as the standard. Several resistance coils had been submitted for examination, and had been returned with certificates to the effect that they had been compared with the B. A. units, and that at *a* deg. Cent. the resistance equalled *p*. B. A. units, or p^1, Rayleigh ohms (1 B. A. units = .9867 Rayleigh ohms). The coefficient of variation for temperature was not stated, as it could be determined by any electrician for himself. The original standards were single units, and during the year ether standards of 10, 100, and 1,000 units had been made from them, under special precautions as regards accuracy, which he described in detail. He also stated that Dr. Muirhead had completed three air condensers as standards, and that the Committee asked to be reappointed.

Secondary Batteries.

After the reading of a paper on electrical launches, Sir W. Siemens said that from his knowledge of the behaviour of these launches they promised excellent results. The question was, What was the secondary battery going to do for us? Was it going to last, or was it a perishable institution? In order to test the question quietly he put down secondary batteries in his own house last autumn. He charged them by means of a very small half-horse power engine, and the result so far had been very satisfactory. He had lighted his house by the small engine with the aid of the secondary battery with great effect, using 40 incandescent lamps from half-past 7 in the evening until 1 or 2 o'clock. He started his engine at 8 o'clock in the morning, and in the evening he had a sufficient accumulation of energy in the battery to last the length of time it was required. In the case of the launch the machine could not be taken with it, and the batteries would occasionally have to be charged. Therefore, he would limit the application of the electric power to navigation to short stages. The cost of the use of steam power and electric storage would be about equal, but the latter would give advantages in weight and space.

An Impregnable Safe.—The National City Bank at Cleveland lately found that the time-lock of its safe was out of order. All efforts to open it having proved fruitless, the masonry in which it was embedded had to be pulled down, and the safe conveyed to some neighbouring ironworks, and there blown open with dynamite.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE third session of this Society was opened on Wednesday, 26th September, under extremely favourable circumstances, both so far as the attendance was concerned and in the selection of the speakers. The chair was occupied by the president (Mr. R. C. Johnson, F.R.A.S.), who said it was customary on the first evening of a session for the president to deliver an opening address. They had had the good fortune, however, to secure the attendance of Professor E. C. Pickering, who had been kind enough to take this duty upon himself. He was sure they would be anxious to hear the remarks of Mr. Pickering, so he would, without trespassing upon their patience, introduce him.

Professor Pickering, who was received with applause, said: Mr. President, the encouragement of astronomy, which your society has in view, is an important work, and it gives me great pleasure to address you. I would speak to-night more particularly about the work to be done in connection with stellar light and stellar variation. In this branch of astronomy valuable work can be done with the unassisted eye or with a small telescope or opera glass. First of all, as regards star magnitudes, the earliest catalogue, that of Ptolemy, dates nearly 2,000 years ago. In it the determinations of brightness are shown by numbers. The faintest star has the number *six* affixed, and the brightest, one. But as there are many stars of the same magnitude and yet differing slightly in brightness, the Greek letters *μ* or *ε* were affixed, signifying the words *μειζων* or *ελασσων* (greater or less). Various copies of this work are in existence, and valuable work might be done by a gentleman, who possessed classical and astronomical skill, compiling the differences of these copies. The variation between the MSS. is very considerable. Baily found that the assigned magnitudes, or positions, varied in three-fourths of the total number of stars. The great authority at present is a 9th-century MS. at Paris, in the national library. A century ago Sir W. Herschel commenced his photometric measures, his method being to speak of a star as brighter or fainter than some other star. He designated small differences of magnitude by means of a period, a comma, or a dash, and their combinations; four catalogues are given in the "Philosophical Transactions." They attracted little attention, however, as there were no absolute determinations of magnitude. At Harvard College all the stars, down to 6th mag., inclusive, have been photometrically observed, and by means of these measures we have been able to represent in numbers the estimates of Herschel. But these four catalogues refer only to parts of the sky. Only two-thirds are there given. Whilst in London I was allowed, by the kindness of the possessors of the original manuscripts of Sir W. Herschel, to inspect them, and amongst them I found two more catalogues which had remained unpublished. A note was attached in Miss Caroline Herschel's handwriting, stating that they were ready for the press. They had been left to Sir John Herschel, and probably through pressure of work he did not publish them, or else did not realise their value. I was allowed to make a copy of these two catalogues, and have forwarded them to Harvard. No similar work of equal accuracy has appeared till within the last ten years. Half a century later Argelander, the greatest observer perhaps who has ever lived, discovered the same method independently, and for a long time—so slow was intercommunication in those days—was not aware of Sir W. Herschel's earlier work. Argelander's method is one of the most precise. The principal difference between his and Herschel's is, that the former used a notation while he used numbers. If the difference was small, he called it "one grade," if distinctly visible, "two grades," and so on. There are 25,000 observations of his in the "Bonn Observations." The great difficulty at present which any one studying the magnitudes of the stars as they were in former years encountered is that the various observations of them are scattered far and wide in various periodicals. The results of these observations we hope to collect in one volume. While at Bonn I was allowed to see Argelander's observations. There were some 3,000 or 4,000, referring to the variable stars. By the kindness of Professor Schönfeld I was allowed to copy them. As many of them were written in the dark, probably with the eye at the telescope, it was a work of some difficulty to decipher them. The amount of unpublished observations is very great. No piece of work is accessible to all till it is printed. At present I find, speaking from memory, that there must be nearly 170,000 unpublished observations, and not more than 40,000 published. It is greatly to be regretted that they should thus be left to accumulate, and perhaps in the end never get into print. Here let me point out a source of error liable to occur in Argelander and Herschel's method. This is due to the effect of one star's position with regard to another. Two stars, apparently equal, show a difference when placed one above the other. Through the varying positions of the stars, as presented to the observer, have arisen many of the cases of suspected variations. The suspected variable stars amount to no fewer than 1,500, according to the list compiled at Harvard; but many of them may have been suspected of variation through the cause just mentioned. Valuable contributions would be made to our knowledge if it could be determined why this apparent variation, due to position, exists. How very remarkable it is, is shown by our observations to determine the constancy of the Pole star. To accomplish this we compared it with several other stars. The method was, each evening, to look at the Pole star, and then at the other star, and see which was the brightest. We soon found a marked deviation; for instance, comparing it with *γ* Cassiopeiæ, we found it $\frac{3}{10}$ths fainter, and the difference in a year amounted to half a magnitude. Other stars gave similar results; but it was found that while *γ* described a curve in one way, *ε* deviated in the opposite way. The same result was obtained with *β* Ursæ Minoris. Arranging observations according to position, we got curves, and found on applying the correction for position that the curves became equal. The question is worthy of further investigation, and I would suggest the following ways:—(1) To look at the stars near the Pole at different seasons of the year, or, as can be done more conveniently, in your greater northern latitude early in the evening and late in the morning; (2) by inverting the positions by means of a looking glass; (3) by watching stars in the zenith lying down on the ground, and then turning round and looking up at them in a different position. The brightest stars are less important than the fainter ones, because sufficiently observed elsewhere. The stars below the 6th mag. are very little observed. Valuable work might be done by determining the magnitude of the stars visible in an opera glass, in the manner of Argelander and Herschel; and especially I would recommend those stars near the Pole. Another piece of work not less valuable might be done in determining the brightness of Uranus and Neptune, and of the Asteroids, some of which are probably variable. We know that one of the satellites of Saturn, Japetus, varies very greatly in light; and it has been suggested, with great probability of truth, that one side is capable of reflecting more light than the other, and so we have a means of determining the time of rotation through observations of its variation. The Asteroids may vary in the same way; and the value of the observations lies in the fact that we shall thus have a probability of finding the time of rotation on their axes. Similar observations of Uranus and Neptune might be made; but, probably, the differences would not be large. Not much value can be assigned to the times of rotation of these planets as hitherto determined. But this method of watching the variation may be valuable as determining the times of rotation of those bodies on which we are not able to see markings. Thus it is impossible to measure the diameters of the fixed stars, as we never have, and, in all probability, never shall be able to observe their discs. The diameter of the brightest star does not exceed a few hundredths of a second of arc, corresponding to as many feet at a distance of 4,000 miles. But it may be possible to tell the size of bodies whose discs are invisible with precision. For instance, in 1877 and 1879 we made determinations of the brightness of the satellites of Mars, and found that, if of the same material as Mars, they could only have a diameter of six or seven miles. We can tell their relative diameter by their measures with greater accuracy than has yet been attained for Mars itself. Again, Vesta might be compared with various stars throughout the year; by this means a list of comparison stars would be obtained, stretching right round the heavens. Another advantage would be that as the Asteroid varies with its distance from the earth, we can compute what the variation should be, and so correct our eye estimation. Another field is one in which good work is being done by your society—viz., the observation of suspected variable stars. The greater part of these are visible to the naked eye, and are thus easily observed, so that the greater part of the work may be done without any instrumental help. A great point would be gained, even if the results were purely negative, as these stars could then be removed from the lists of suspected variables. Yet another point is the observation of the variation of absorption. This consists merely of watching stars, and estimating the brightness of stars on the horizon and in the zenith. All that is necessary is to compare carefully a star on the horizon with a star near the zenith. These observations should be made in various places. In America the pure sky of Italy has become proverbial, and I had hoped to have reduced this poetical saying to a mathematical figure. But, with the exception of one opportunity, I was unable to make the determinations I had intended doing while travelling from place to place. This exception was an the Rhigi, with a field glass. Some stars near the horizon were compared with stars in the zenith, and I hope hereafter to reduce the results thus obtained. But the subject commends itself to travellers, and I hope any member of your Society, who has the chance, may attempt this kind of work.

The President said a communication had been received from Mr. E. F. Sawyer, of Cambridgeport, U.S.A., on some observations he had made on the variable star R Coronæ, from 1881 to the present time. He suggested that this star should be closely watched by astonomers.

The Rev. T. E. Espin, B.A., gave a brief account of the work done at the Society's observatory.

Eight candidates were proposed for election, and the proceedings closed with a vote of thanks to the lecturer.

SCIENTIFIC NEWS.

AT the closing meeting of the British Association, Prof. Cayley, the president, stated that Southport had done everything it could to make the meeting a success, and Prof. Williamson reported that the attendance had been over 2,700—more than were present at the York meeting. The new annual members numbered 323, the associates 952, and the ladies 841.

Altogether a total sum of £1,445 was apportioned in grants, the most remarkable item (in one sense) being £5 for patent legislation, the largest £500 for exploring Kilimanjaro and the adjoining mountains of Equatorial Africa; £80 is awarded to the biological table at Naples; £100 to the exploration of New Guinea; £75 for earthquake phenomena of Japan; £50 for meteorological observations on Ben Nevis; and £25 for the meteorological observatory near Chepstow. The remainder of the sum total is divided amongst the usual subjects.

Amongst the recommendations of sections approved by the Council, is one in which the Committee of the Fisheries Exhibition is urged to appropriate a sum of money to found a zoological laboratory on the British Coast; another is an application to the Admiralty to institute a biological survey of Milford Haven and the adjacent coast; and yet another is the suggestion to form a separate section for anthropology, leaving section D with the title biology, zoology, botany, and physiology.

The Council have taken the "election of members" under their control until further notice, for a reason which, in view of the visit to Canada, is obvious.

According to the *Times*, Dr. Schuster has "reduced to a decimal point the exact constitution of the sun."

Dr. Wentworth Erck writes that Comet Pons-Brooks was seen at Shankill, Bray, on Sept. 24. With 7½in. aperture, it presented the appearance of a nearly circular nebulous mass 2′ in diameter, with a slight central condensation. Dr. Erck says it can be seen with 1in. aperture, and will soon be visible in an opera-glass. The following extract from the ephemeris of MM. Schulhof and Bossert may be useful. It is for Berlin midnight:—

	R. A.			N. Dec.		
Oct. 5	16h.	29m.	48·20s.	57°	55′	43·1″
7	16	31	18·54	57	30	10·1
9	16	32	50·08	57	4	52·5
11	16	34	37·73	56	39	51·2

There are six known comets having calculated periods of about 70 years; but of these the only proved periodic is Halley's, which last appeared in 1835, and our present visitor, which there seems no reason to doubt is Comet Pons, 1812.

The Treasury having declined to defray the expenses of erecting a telegraph wire between the summit of Ben Nevis and Fort William, the Council of the Meteorological Society have determined to rent a wire of the Post Office, which will be available for the public service as well as for the purposes of the observatory.

The arrangements for the Gresham lectures during the present session are as follows:—Rhetoric (Mr. J. E. Nixon), Oct. 9th, 10th, 11th, and 12th; astronomy (Rev. E. Ledger), 16th, 17th, 18th, and 19th; geometry (Dean Cowie), 23rd, 24th, 25th, and 26th; law (Dr. Abdy), Oct. 30th and 31st and Nov. 1st and 2nd; divinity (Dean Burgon), Nov. 5th, 6th, 7th, and 8th; and music (Dr. H. Wyide), 13th, 14th, 15th, and 16th.

Mr. W. E. Crowther, of the Manchester Technical School, has written a circular letter, in which he regrets that the subject of Hygiene is "placed in a more unfavourable position financially than any other science subject" of the Science and Art Department. Mr. Crowther says that the department annually obtains from Parliament £340,000 or thereabouts, out of which only 5s. 9d. in the pound is given to the direct encouragement of national science and art instruction, the remaining 14s. 3d. being "absorbed" at South Kensington and Dublin. We cannot spare space to reproduce Mr. Crowther's letter; but he will, no doubt, supply copies to all interested, and it is specially interesting to science teachers and students.

The subject for the Howard Medal of the Statistical Society is "The Preservation of Health, as it is affected by Personal Habits, such as Cleanliness, Temperance," &c. The essays must be sent in by the 30th of June, 1884.

The Franklin Institute of Pennsylvania is making arrangements to hold an International Electrical Exhibition at Philadelphia, to open on Sept. 2, 1884. The Government has authorised the admission of all articles free from duty or customs fees, which will be payable only if the articles are sold or consumed in the United States. Full information can be obtained of the Secretary, Franklin Institute, Philadelphia, Penna., U.S.A.

An International Exhibition of Art, Manufactures, Science, and Industry will be held at the Crystal Palace from April 3 to October 31, 1884. Full particulars can be obtained of Mr. G. C. Levey.

The Department of Applied Science and Technology at University College, London, opened last Tuesday, under the direction of Prof. A. B. W. Kennedy, Prof. Vernon-Harcourt, Prof. C. Graham, and others. The instruction includes civil and mechanical engineering, surveying, drawing, and experimental work in the laboratory, chemistry in its various technical branches, architecture and construction. The engineering laboratory of this college affords an excellent opportunity for students to acquire practical knowledge of their profession.

It is stated that Mr. W. S. Cowell, of Lowell, Mass., has succeeded in making a bisulphide of carbon engine that is free from objections. We shall see.

The Pearl Life Assurance Company.—The nineteenth annual report of this company is one of continued prosperity. Two hundred and twenty-two thousand and thirty policies have been issued during the year, representing a new annual premium income of £103,837 15s. 8½d. Premiums from one halfpenny per week may now be paid either weekly, monthly, quarterly, half-yearly, or yearly, to meet the requirements of all classes. The total amount of premiums received by the company for the twelve months ending June last amounted to £126,239 8s. 7d., being an increase of more than £16,000 over the previous year's income. On the policies in force on the company's books at the end of the financial year the annual premium income equalled £153,661 10s. 8d. Seven thousand four hundred and ninety-one claims and grants, amounting to £44,877 19s. 7½d., have been paid by the company in the twelve months ending June, 1883, and the amount paid by the company since its incorporation equals £225,482 16s. 6d. At the Victoria Hall, Sunderland, fifteen of the company's policyholders lost their little ones, on behalf of some of whom only a few pence had been paid. The representative was, however, in all cases instructed to settle their claims at once and in full.

The *Neueste Erfinderung* describes an anti-corrosion paint for iron. It states that if 10 per cent. of burnt magnesia, or even baryta or strontia, is mixed cold with ordinary linseed oil paint, and then enough mineral oil to envelop the alkaline earth, the free acid of the paint will be neutralised, while the iron will be protected by the permanent alkaline action of the paint. Iron to be buried in damp earth may be painted with a mixture of 100 parts of resin (colophony), 25 parts of gutta-percha, and 50 parts of paraffin, to which 20 parts of magnesia and some mineral oil have been added.

To encourage tree planting the legislature of New York State passed a law by which any inhabitants who shall transplant by the side of the public highway adjoining his premises any forest shade trees, fruit trees, ornamental trees, or any nut-bearing trees, shall be allowed, in abatement of his highway tax, 1 dol. for every four trees set out. Elms must be placed not less than 70ft. apart on the same side of such highway, and no maples or other forest trees, ornamental, or fruit tree, nearer than 40ft. apart on the same side of such highway.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

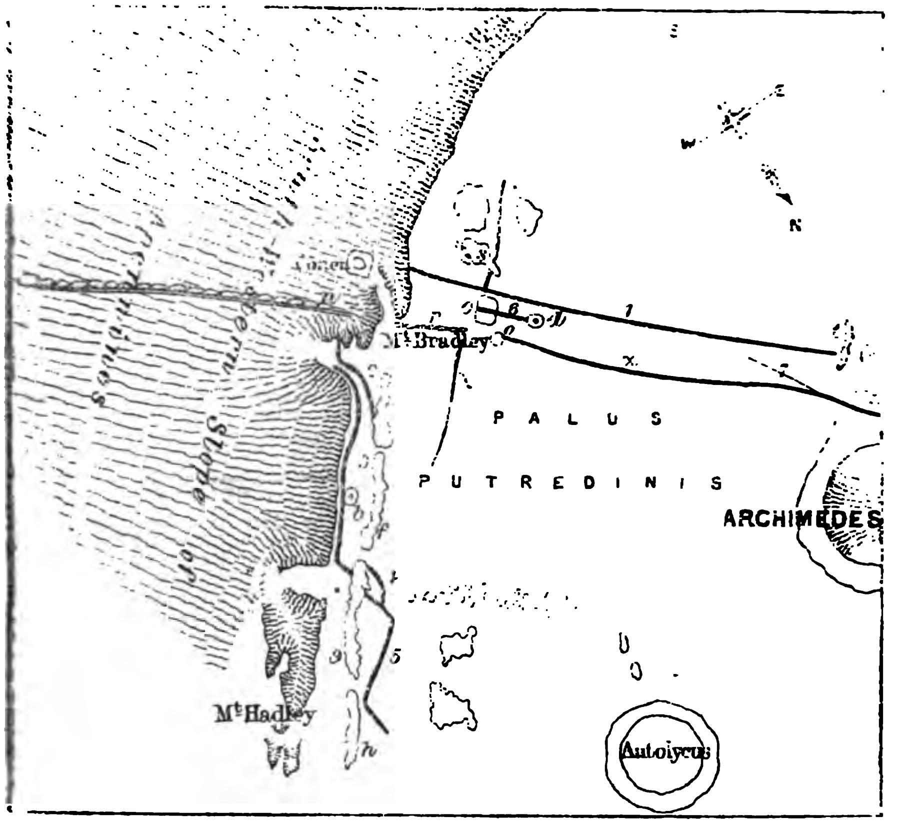
"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

ASTRONOMICAL—β DELPHINI—δ EQUULEI.

[21876.]—As there is nothing like trying, I thought, after reading letter 21796, that I might turn my telescope on δ Equulei and β Delphini, to see what I could do. The air was good, but not as good as one would like when examining such very delicate and difficult objects with an 8½in. mirror. β Delphini was seen at once, eggshaped, and with power about 1,000, at times notched at very short intervals, the companion being seen in position 200° ±. I have examined it several times afterwards, and always with the same results. I have found δ Equulei more difficult than β Delphini, and I cannot be so sure of the position of the *comes*. On Sept. 15 and 16 I thought the companion was in position 20° ±; but on the 18th, and with power 450 ±, it seemed to me it was in position 130° ±. I again noticed on this occasion that it is more difficult than β Delphini. Will "H. S." tell me if I have seen right, or if what I have seen is the result of a faulty adjustment? I hope Mr. Perry will soon give us his measures. **C. Gaudibert.**

SELENOGRAPHICAL — CLEFTS BETWEEN ARCHIMEDES AND THE LUNAR APENNINES—ARCHIMEDES.

[21877.]—ON 22nd September, 13h. to 15h., the longitude of the terminator being about 14° west, I obtained an unusually fine view of some of the clefts which extend from the hilly region on the S.W. side of Archimedes to the Apennines in the neighbourhood of Mt. Bradley, and also of a remarkable group which runs parallel, or nearly so, to this grand mountain system. The accompanying diagram shows the general direction of those observed; but, of course, can convey no idea of the extreme delicacy of most of them, nor of the beauty of their surroundings under almost perfect definition with a power of 350 on my 8½in. Calver reflector. In comparing my sketch with B. and M.'s, and Neison's map, I recognise χ as answering to the cleft so lettered by them. This delicate object commences as a valley on the S.E. side of Archimedes, and appears to terminate *as a cleft* a little to the E. of Mt. Bradley; a row of hillocks bounding a valley, traceable through all the intricate detail of the slope of the Apennines to *m*, seems to follow the direction of its imaginary prolongation from *n* to *m*, towards the S.W. This coincidence of direction between the cleft χ and the narrow valley *n m* can hardly be fortuitous, though the vast difference of level, amounting to thousands of feet, between the latter and the cleft on the plain beneath renders the connection between the two features strange if true. A very faint, short cleft, 7, was seen branching from χ near the well-known spur on the S. slope of the wall of Archimedes and proceeding towards cleft marked 1. The latter cleft was easily traced from the escarpment of the Apennines E. of Conon to a ridge *t*, south of Archimedes. It seems to agree with Neison's χ^2, though in his map IX, it is shown as terminating near the cleft λ. Between the clefts χ and 1 I remarked a short cleft 6, passing through the object *c* and terminating at a craterlet *d*. The S.E. portion of the cleft λ was very distinctly defined. It appears to be continuous till it encounters a spur from the low mountain *s*. A second interruption occurs where it meets cleft 1, and, though it was not traced between clefts 1 and χ, it became again prominent on the N.W. side of χ, and could be seen extending far away across the *Palus Putredinis* towards cleft 5, with which, probably, it is connected. Running nearly parallel to the escarpment of the Apennines from near Mt. Bradley to Mt. Hadley, is a range of hills or ridges marked *f*, *g*, *h*; and between these and the mountain range is a well-marked cleft 3, which was traced close under the foot of the cliffs, passing between it and a craterlet *b*, to the south side of the hill *g*. Another cleft, 2, curves round the E. side of the cliff concentrically with it, and runs to th



W. side of the hill *f*. A third cleft 5, was traced from the E. side of *g*; at first taking a N. direction, it suddenly turns to the N.W. till it reaches E. side of *h*, when it again trends N. for a short distance. A fourth cleft, 4, branches out from 5 and curves round to E. side of *g*, as shown. There can be little doubt if this region were carefully scrutinised with sufficient optical power, especially near lunar sunset, a large addition to the clefts at present known would be made, and, possibly, new light thrown on the origin of these (at present) inexplicable formations.

Archimedes.—In reference to letters Nos. 21706, [illegible], relating to the light streaks on the floor of Archimedes being seen to cross the W. wall and extend beyond it, I may inform Mr. B. J. Hopkins and Mr. F. S. Davenport that I have frequently remarked this peculiar phenomenon when Archimedes is under a high sun. A noteworthy fact in connection with it is that those portions of the wall and glacis which are traversed by the light bands are then abnormally bright.

Kempston, Beds. **Thos. Gwyn Elger.**

SELENOGRAPHICAL—ARCHIMEDES—CLEFTS NEAR MESSIER A.

[21876.]—Your correspondents Mr. B. J. Hopkins (let. 21706) and F. T. Davenport (let. [illegible]) must not suppose that the prolongation towards Autolycus of the rays crossing the floor of Archimedes is new. I have seen it myself again and again, and Dr. Julius Schmidt notices it in his observations of April 21, 1858. It is visible near or in full moon.

On Sept. 25, 1877 (Eng. Mech. No 655, p. 116), I discovered a cleft on the N.E. side of Messier A. I had no opportunity of seeing it again until Sept. 28, 1883, when a prolongation of the same was seen from crater 10 to near crater 17. Another cleft was also seen, running in a N.—S. direction, passing where the letter H is placed in my sketch, and nearly reaching the old cleft, with which it would form a right angle if it did reach it. The sides of this last cleft are very much broken, and it runs in very short zigzags.

I am sorry to see that no signs of the labours of the Selenographical Society are published in your pages. This silence makes one regret the time when the English Mechanic was the means of conveying to its readers so much interesting information on this branch of astronomy.

Sept. [illegible]. **C. Gaudibert.**

VISIBILITY OF VENUS DURING SEPTEMBER.

[2187[illegible].]—Mr. Flanks (letter 21851, p. 86) is quite correct in his surmise that our "Astronomical Notes" are intended "for the possessors of moderate-sized telescopes": but even they, we venture to think, would scarcely care to employ them (as a mere *tour de force*) in the finding of, and gazing at, a sensibly circular little disc of less than 10″ in diameter in the glare of sunlight. Had Venus been coming into inferior conjunction we should most assuredly have continued our ephemeris during the whole period, as she would then have presented an all-repaying spectacle to the observer when once fairly caught. Under existing circumstances, the exigencies of space in the columns of the English Mechanic compel us to exclude everything that is not of immediate interest to the amateur observer. It will doubtless be possible to find Venus during October. As to what satisfactory scrutiny of her can be made, or how far she will be worth looking at when found, we shall be glad to have the opinion of our readers.

The Writer of the Astronomical Notes.

THE LIVERPOOL ASTRONOMICAL SOCIETY.

[21880.]—In matters celestial I do not think there is much that would escape the notice of our energetic observer, but he has missed a point in his reference to the Liverpool Astronomical Society that I should like to call attention to. It appears to me that the title of the Society is, in itself, likely to create an impression that it has been established solely for the convenience of local amateurs. This feeling is, indeeed, evident in many of the letters I have received, and I am afraid that much valuable co-operation has been altogether withheld for this reason alone. It should be remembered that astronomy differs from most sciences in being independent of locality, and that celestial observations are, in fact, the more reliable in proportion to the difference in distance and other conditions under which they are made; therefore I hope that none of "Ours" will refrain from joining, simply because they happen to live a few hundred miles away. It is true, as Mr. Espin has said, that "from every side the most cordial support of well-known astronomers has been received," and how can we better show an appreciation of their kindness than by collecting large numbers to benefit by their instructions?

The annual subscription of 5s. is, of course, merely nominal, and would not nearly cover the expenditure in a small society. That we commence our third session with a small surplus is certainly a hopeful sign; but much more is needed before we can take the position we finally hope to do, as intermediate to the amateur public and the Royal Astronomical Society.

W. H. Davies.

Hon. Sec. Liverpool Astronomical Society.

PROFESSOR BALL ON THE MEASUREMENT OF THE SUN'S DISTANCE.

[21881.]—In his address on this subject, as appearing in the Mechanic, he says that if it were possible to transplant the instrument and apparatus, operator, and all after measuring, &c., to the other station, &c., the means would be attained. As this will be an impossibility, "Mohammed" must go to the mountain if the mountain won't come to him, and that it will not. It has occurred to me that were two stations in electric communication, and the instant of measuring at them thereby known the thing would be done. And why, if this can be done, every station in the world could be in electric communication with each other. Practically knowing as I do nothing of the instruments and apparatus used by astronomers, I cannot say anything beyond the fact that the means of instant communication over this globe is in their hands and at their service by the electric telegraph, and if the game is worth the candle, I cannot see why it should not be used. Then, again, if the telephone, which from all accounts has been brought to travel great distances, is used, it will become of the most certain advantage.

P. W. R.

WOODEN CHUCKS.

[21882.]—Of the wooden chucks mentioned by Dr. Edmunds (page 62), I cannot speak from comparison, having neither spring nor self-centring ones, but I can fully corroborate their efficiency and exactness for delicate work, such as microscopic apparatus, with which I have been for some time amusing myself. At first I used yew, but gave it up for beech, which, I think, has a better grip. Instead of fitting a chuck upon the mandrel, I drive a piece of wood into a bell-chuck, leaving about 2in. clear to work upon, which often serves me for a good while. My mandrel not being drilled throughout, but only about a third of its length, the hole terminating in a slot, I cannot tap the work out so readily; though I must tap it out when it is a small surface that is being faced up. Generally I put a small brass disc faced with leather into the chuck before the work, which has a threaded hole in its centre, so that a piece of thick wire can be screwed into it, and the work easily and safely drawn out when finished, or before, for I frequently take out and replace, without any sign of "off true." I give this for the benefit of "non-drilled mandrels," who may be apt to mar a bit of delicate work in trying to pick it out.

J. A. C.

LATHE MANDRELS.

[21883.]—At the courteous invitation from Dr. Edmunds, I beg to offer the following criticisms on his standard mandrel:—I would propose 1in. instead of 1·05 for the cylindrical portion of the nose, and ·95 for the diameter of the screw. The former, being the most important part as regards securing immobility and the interchange of chucks, should have the simpler dimension, and this would best be given in the mode proposed by **A "Fool."**

ORNAMENTAL TURNING AND THE PROPOSED STANDARD MANDREL.

[21884.]—General Clarke's help on the question of a standard mandrel will be of great value. He is not a mere manufacturer of "gimcracks in ivory and blackwood," but a leader-artist in ornamental lathework, and one who will be as ready to see justice done to the facts as to Mr. Holtzapffel. If I have done any injustice to Mr. Holtzapffel, I shall be anxious to set myself right: but at present I have only to point out the General's carelessness in imputing to me words which I had not used. I never described the engraving as "Mr. Holtzapffel's ideal of a *mandrel*-nose."

The engraving in question had been drawn and published by Mr. J. J. Holtzapffel as a model for cutting "the hardwood or ivory external screw, of large or small diameter." In the text of my paper I point out how the engraving differs from his steel mandrel-nose, and nowhere do I speak of his steel mandrel-nose as being represented by this engraving otherwise than in its general character. My words are: "Certainly the engraving represents the shallow thread used for ivory, hardwood, or cast-iron, and is flattened off at the top much more than is the deep thread used upon the steel mandrel-nose; but the measurements of the lathe-noses (table VIII.) show that, in other respects, it represents very fairly Mr. J. J. Holtzapffel's notion of an ideal screw-nose. Against that ideal for a screw-nose of any sort—wood, ivory, or metal—I beg leave to enter a protest."

I gave the dimensions of Fig. 512, which I will call the ivory screw-nose, as follows:—Length, ·870in.; diameter, outside thread, ·770in.; at bottom of thread, ·570in.; in groove at base of nose, ·470in. The threaded nose has a diameter midway between the full cylinder and the stem = ·670in., and gives a sectional area of ·3526 square inch, while the base of the nose at the point where all the strain falls has a diameter of ·470in. and a sectional area of ·1735 square inch. My reproduction is a close facsimile of Mr. Holtzapffel's engraving, and my figured measurements are correct. I reproduced the engraving in order to give substance to a protest against such a model being set up before us for any screw-nose whatever whether in wood, ivory, or metal.

Not only did I never represent the Holtzapffel mandrel-nose as like this ivory screw-nose, but I names, and in consequence, what is called negative is, in fact, the true positive state. As a parallel example, a compass needle points to the north, and the end that does so is called the north pole, although it really possesses the same kind of magnetism as the true south pole of the earth.

In a galvanic battery, the carbon terminal is commonly called positive; but the electric current is thought to pass from the zinc terminal along the wire to the carbon, and that the carbon serves only as a conductor, it having no electric action whatever.

Positive electricity only is considered to exist; the negative is merely a lower positive state; just as ice is hot or in a positive state when compared with frozen quicksilver, or hot water is cold or negative compared to melted iron. The experiment with the card only proves that a hole is made in the card with a burr on each side: the phenomenon can be explained several ways. **J. Sutcliffe.**

THEORY AND CONSTRUCTION OF THE HELIOSTAT.—III.

A Heliostat with one Reflection.

[21888.]—The instrument about to be described is in principle similar (or so the writer believes) to that of Gambey; but it has received some improvements from Mr. Johnstone Stoney. Its geometrical theory was described on page 41 of this volume. The following are practical directions for constructing it. It ought to be premised, however, that the cut, Fig. 5, is not taken from one of those instruments ordinarily sold, having a wooden base and a French clock attached by a band; but is taken from a photograph of one in the writer's possession, and no instrument-maker is responsible for it. At the same time it is one which performs well, and appears to the writer to be more easily constructed by an amateur who, though possessing a tolerably well appointed workshop, is yet unable to do "dividing" with any accuracy.

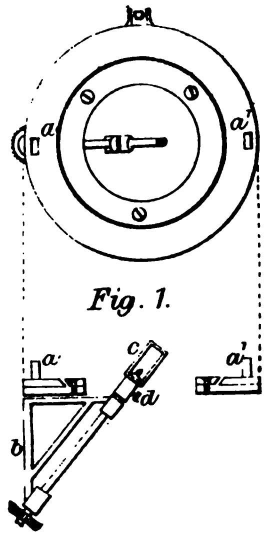


Fig. 1.

Those, however, who prefer Stoney's form will see a good cut of it on page 271 of the last edition of "Captain Abney's Photography."

The first thing to do is to prepare patterns for the three brass rings seen in Fig. 1. One of these, the lower, is 5in. outside diameter and 3in. inside; the other two when put together make a ring the same size and shape as the first, but are arranged as seen in the figure, so that when the inner ring is screwed down to the lower one, as shown, the outside upper ring can revolve stiffly on the others in its own plane, being held down by the slant edges of the inner ring.

These rings must be cast, faced, and turned up true in the lathe. *A* and *a'*, Fig. 1, are two little pieces which may either be cast in one piece with the movable ring, or attached afterwards.

They should be accurately set on a diameter of the ring and equidistant from the edge. Their office is to serve as bearings in which the piece, Fig. 3, can turn about the screw-centres A B.

The piece *b*, Fig. 1, should next be cast and screwed to the under ring. It must be so constructed that the line of the holes in which the polar axis is destined to revolve shall make with the shorter side of the piece an angle equal to the latitude of the place where the instrument is to be used. It must not be attached to the ring until the polar axis, presently to be described, is ready, as the necessary adjustment involves the three pieces at once. The polar axis is seen in Fig. 1 and Fig. 2. It consists of a piece of bright steel rod fitting nicely through the holes in the piece *b*, and having a piece of brass slipped over its upper end of the shape shown in the figure. This piece, *c*, Figs. 1 and 2, is to form a bearing for the sun-pointer *a c*, Fig. 2. It should fit over the polar axis without play, but not too tight to revolve independently. A small screw *d*, Figs. 1 and 2, will clamp it to the axis when the instrument is working. Two bevel wheels must be procured (it is assumed that no facilities for cutting them at home will probably be possessed). One of them *b*, Fig. 2, must have twice as many teeth as the other, and they must be so cut as to work when their axes are at an angle equal to the latitude. These can be procured in London for about 2s.

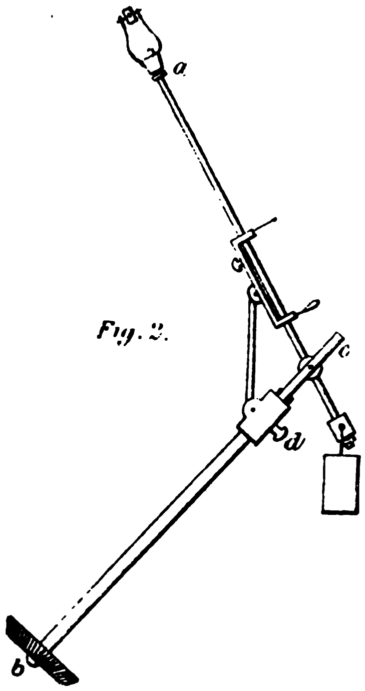


Fig. 2.

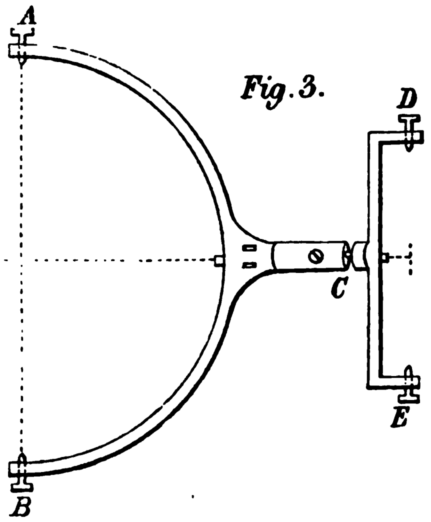


Fig. 3.

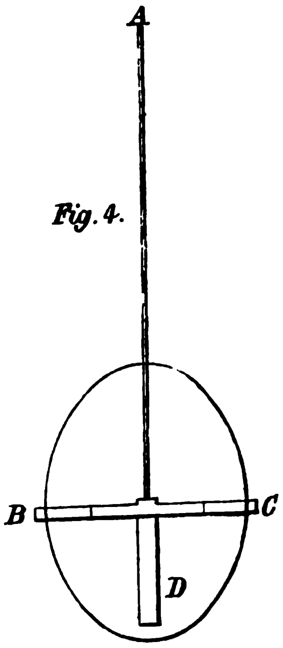


Fig. 4.

The larger of these is to be fixed quite tightly over the lower end of the polar axis, which is then to be passed through the pieces *b* and *c*, Fig. 1. Two little capstan-headed nuts are screwed finally over the upper end of the steel rod, one jamming on the other, and holding the polar axis so that it can turn easily without having endway motion. The piece *b* should now be temporarily cemented to the lower ring in the position shown in the figure, and the movable ring turned to a position at right angles to that shown in Fig. 1—that is, so that the two little projections *a a'* shall be at the extremities of what is destined to be an east and west diameter. Now, the position of the piece *b* on the rings should be shifted until a continuous small hole can be drilled through *a a'*, and the two sides of *c* at the centre of the parallelogram, while a rod passed through this hole should be bisected by the polar axis. This is the first important adjustment, and when this is satisfactorily arranged the piece *b* may be fastened to the under ring with screws.

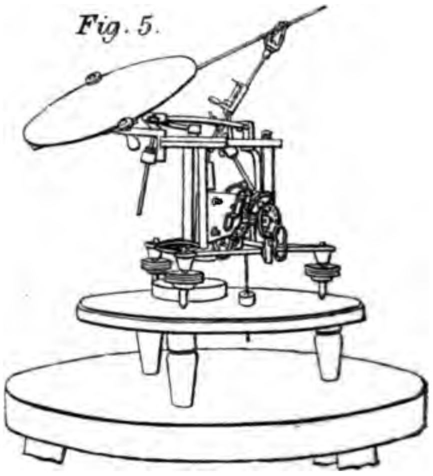


Fig. 5.

A. T. Hare.

(*To be continued.*)

TRANSFER OF THOUGHT.

[21889.]—It is a remarkable thing that a great many people will leave the real subject of a discussion in order to fasten upon some incidental detail, and attack an analogy rather than an argument, forgetting that in no case can an analogy be carried beyond a certain point, and that when it is carried further it becomes unmeaning. This is just what E. T. Scott (21858, p. 87) does when he asks me if I "mean to say that ether and chloroform have the same effect on us as mesmerism." I never said anything of the kind. I pointed out that precisely the same kind of objections as are now raised to thought transfer were urged against the possibility of a painless condition being produced. The argument raised by the medical men was that it was impossible that a serious surgical operation could be performed without pain to the subject: that argument was raised against the principle of possible painlessness; it was directed against mesmerism because it was only by mesmerism that it was claimed that the painless condition could be produced. My argument now is, that the discovery of ether and chloroform disproved the argument of impossibility, by proving that the painless condition was a real fact. Whether the action of ether and mesmerism is alike or not has nothing to do with the matter, except in so far that as no one knows *how* ether acts, those who know the fact have no right to deny the corresponding mesmeric fact because we cannot explain how it occurs. But this I do know, that ether and other anæsthetics act first upon the nerves of sensation, then upon the consciousness, and finally upon the great organic nervous system, and when this occurs the patient dies; but mesmerism never acts upon these latter, except by concentrating the vital energies upon them, and so enabling them to act fully and do their work. Hence the flurried feeble pulse becomes full and steady under mesmeric action, as I have often noticed.

Mr. W. J. Grey (21859, p. 87) complains of my "dogmatic tone." I believe dogmatism means the enforcement of an opinion by authority; now, I have not endeavoured to enforce an opinion at [illegible] who goes upon the stage and behind the scenes knows more of the play than he who sits in pit or gallery, and sees only the glamour and the lights.

As for "The Congregational Minister," I, having read the history of the "Cock-lane Ghost," the "Sisters Paterson," "The Davenport Brothers," (Dr.) Slade, the "Welsh Fasting Girl," and a host of other deceptions, should not remain satisfied with the performances of a young lady whose father kept always close to her as *an indispensable condition*. Let him test her in his own study alone, and by some surer tests than those afforded by such pitiful mountebank tricks as telling a card. Why, I have seen dogs and ponies do that, and have myself done some things that would perhaps astonish "The Congregational Minister."

It has been said, wisely or unwisely, that the world is composed of two sets, knaves and fools. Let us at least make an effort to avoid either category. **James Rhodes.**

TRANSFER OF THOUGHT.

[21891.]—I am glad to see by the remarks of "Sigma" in his letter 21856, page 87, that his objections are not directed against scientific inquiry into the "unknown." Surely, then, if "thought" is always accompanied by motion of brain matter, it is as much an "assumption" or "assertion" to say that this motion is caused by thought or mind as an "entity," using "brain" like a workman using his tools, as to conclude that the activity or motion of the brain, caused by impressions from without, produces thought or mind; since "Sigma" correctly observes the "how" of brainwork is not as yet definitely determined.

Having, therefore, two theories before us—viz., "Sigma" holding that "mind is an agent or entity producing motion in brain matter," Büchner, Haeckel, and others holding that "thought or mind is the result of motion in brain matter"—I prefer the latter theory, and hope "Sigma" will agree to differ from me. As to Solomon, I had no wish to quote "Ecclesiastes" in support of the German scientists, but simply to show that quotations from old writers may be produced as well in favour of materialistic views as against them.

Büchner says, in "Force and Matter," page 185:—"Now, in the same manner as the steam-engine produces motion, so does the organic complication of force-endowed materials produce in the animal body a sum of effects, so interwoven as to become a unit, and is then by us called spirit, soul, thought. The sum of these effects is nothing material. It can be perceived by our senses as little as any other simple force, such as magnetism, electricity, &c., merely by its manifestations." **F. W. H.**

[21892.]—"Sigma" and T. H. Carter have my most humble apologies, but my assurances notwithstanding that my opinions remain unchanged. T. H. Carter is a good way on the road to spiritualism, and similar delusions; "Sigma" has only recently started, but both talk exactly like thorough-going spiritualists when anyone plainly says he does not believe them. I cannot see any "gross impertinence" in assuming "fraud or trickery." An extensive acquaintance with ghost literature and the records of the marvellous has convinced me that, whatever may happen in the future, there never has been in the past a pretended miracle, apparition, or similar exhibition of the marvellous but someone played false—not infrequently the most innocent-looking party concerned. But I do *not* assume fraud or trickery From my own experience I know that men cannot long play these kinds of tricks without unconsciously becoming the victims of self-deception. I once tried table-turning with a friend of unimpeachable integrity. The table turned of course, and we both were convinced—the one that the other had turned it. My opinion now is we both did it.

When "Sigma" is expounding electric phenomena he relies on facts and experiments fearlessly; when he strays into the region of the marvellous we are invited, as by all seers, to take him—with a grain of salt. We are to start with an admission of his capability "of careful observation of facts, and that his opinions are *likely* to be more trustworthy, &c., &c." Begging his pardon again, we—or, at least, I—will do nothing of the kind, and if it is rude I really cannot help it. We part company on the threshold of investigation, and I hold him in exactly the same estimation as a respected lady of my acquaintance who, perfectly sane in all other respects, has two crazes: one that she will live to see the Day of Judgment; and the other that carrying an umbrella at any time is an act of superfluity, because no rain can ever fall on her. As wife, mother, and friend she is unexceptionable, so we appreciate her value and virtues, and keep as grave a face as possible when her delusions arise, remembering that each of us is more or less mad on some point. The "madness" of "Sigma," if it be such, may well be excused when we remember the vast benefits he has conferred on "Ours." Mr. T. H. Carter has as yet established no such claim on our consideration, and need not ride the high horse. **Kappa.**

[21893.]—I have been intensely interested in the discussion now going on in the columns of the "E. M." on the above subject. This week there appears (21864) a plain statement of facts respecting my little daughter Lilian. If required, this account could be supplemented by other statements of a like nature, enough to fill all the columns of your journal. These facts cannot be overlooked. It is impossible to explain them away, and I here publicly challenge "Kappa" (21836) or any living man to perform these feats by the aid of any code of signals, or any process of deception whatsoever. This child has been taught absolutely nothing to enable her to perform these feats, by myself nor anyone else. She would perform them equally as well for "Kappa," or any other person, in their own private drawing rooms, without any personal contact, and without the presence of myself or any of her relations or friends, who might be supposed to be accomplices. All that they would be required to do, would be to stand on one side and allow this little child, with *silent, unanswerable argument*, to teach them that there are more things in nature than the greatest thinkers have ever yet thought of. Only last week she taught one of those sceptics of the "Kappa" school, a lesson he said he should never forget as long as he lived. This child has been examined by men of science, eminent medical men, and others who lay claim to be something more than idiots to be imposed upon by such rididulous trickery as insinuated by "Kappa" and others of your correspondents. I believe every word written by T. H. Carter, "Sigma," &c., in their statements of simple facts that have come under their own observation. I advise Mr. Carter to persevere with the children he mentions. I believe he will find that they can perform these feats without contact. I wish particularly that he would try some of those, or similar, experiments he will find detailed in letter 21864. I, for one, should like to know the result. I may tell him that many others are deeply interested. Experiments with contact are always open to such charges as those of "Kappa," although the charges are utterly devoid of truth.

I have not the pleasure of knowing where "Kappa" resides; but if it were possible, I should be pleased to afford him an opportunity of witnessing some of these remarkable experiments, on condition that he would give to the readers of the "E.M." his opinions after he had seen them. I venture to say that his former letter would need a very great deal of revising.

I will not now trespass further upon your space. I will leave it to abler pens than mine to continue this interesting discussion, merely contenting myself with the part of witness, on the affirmative side of the question.

In conclusion, allow me to state that I dare undertake to say that this child would, if in a happy frame of mind, and surrounded by sympathetic persons, perform the following feat. If she succeeded (and she has already done so) I would be content to allow it to speak for itself.

Two entirely new packs of cards shall be produced, so that it could not be said they were in any way marked. One of these packs should be spread out face upwards on any table in four rows: one row for each suit, each row commencing with the ace, and ending with the king. This being done, the other duplicate pack (it need not be the same pattern at the back) shall be opened, and kept face downwards in the hands of any other person. That person shall draw out one card at a time, secretly look at it, and place it, always face downwards on the child's outstretched hand. She will then, in perfect silence, place it face downwards upon the duplicate card lying face upwards upon the table. She will thus continue till all the cards are paired. During the whole process the child can be effectively blindfolded. She will not only pair the cards in this inexplicable manner, but she will do it in a neat and exact way, as precisely as she could do it with her eyes at liberty. What has "Kappa" to say to this? **W. H. Bibby.**

Clayton Bridge, Manchester, Sept. 29.

HYDRAULIC RAMS.

[21894.]—Mr. Davies does not appear even now to recognise the self-contradictory figures that he gives as the result of the working of the ram. I will, therefore, work it out fully. I assume a cube foot of water to contain 6¼ gallons. Energy expended by the descending body of water is 22 cubic feet, weighing 1,375lb. falling 6ft., or 8,250 "foot-pounds." The work done is said to be 3 cubic feet, weighing 187½lb. raised 48ft., or 9,020 "foot-pounds"; that is to say, the work done exceeds the energy expended by 770 foot-pounds, and in addition to this there must be the energy expended in forcing the water through the pipes. I have always understood that the efficiency of a ram is only about ⅔ of the theoretical duty, which would reduce the delivery to about 1⅚ cube feet per minute.

On referring to Molesworth I find he says a ram will raise about one-fourteenth the quantity expended to a height of eight times the fall. This would make the quantity delivered $\frac{22}{14}$, or, rather over 1½ cubic foot per minute, which is even less than my estimate, and just half the quantity mentioned by Mr. Davies.

As Mr. Davies, of course, made his statement in perfect good faith, there is a serious mistake somewhere or other. Taking the figures as Mr. Davies gives them, the ram actually *gave out more work than was put into it*—a result I confess which I cannot reconcile with mechanical principles.

I notice Mr. Davies' quotation from a manufacturer's price list, in which I see nothing wrong, as the manufacturer does not give the *quantity of water expended* in raising the 300 to 4,000 gallons to a height equal to ten times the fall; so no comparison can be made.

The other queries in my former letter Mr. Davies has not replied to. Will he kindly do so? **A. S. L.**

[21895.]—Mr. P. J. Davies (letter 21870) asserts that by the expenditure of 22 cubic feet of water he can lift 3 cubic feet to eight times the height of the fall. Now, as 3 × 8 = 24, and 24 is greater than 22, the work done is clearly more than the power employed, notwithstanding the loss by friction and otherwise. If this be so, the problem of perpetual motion is solved, and water-rams will come into general use. **S. M. C.**

SYMBOLIC EXPRESSION OF FEET AND INCHES.

[21896.]—An "Assoc.M.Inst.C.E." fully confirms the stated advantages of simplicity and facility in writing possessed by the ordinary dash symbols.

Admitting, however, with Mr. Hopkins and "F.R.A.S.," that an alteration, either in the symbols used for minutes and seconds, divisions of the arc, or for the similar ones used for feet and inches, might be somewhat advantageous, the question, then, is whether the symbols for the former should not be altered in preference to those for the latter. Certainly the former have the right of the use of the dash symbols by reason of priority, but the latter are used to an infinitely greater extent. I accept as an improvement Mr. Hopkins's alterations to the symbols suggested by me. **B. H. Thwaite, Assoc.M.Inst.C.E.**

[21897.]—It seems now that Mr. B. J. Hopkins did not mean to advise the use of the symbols pi and delta for feet and inches, for he really prefers the latter (p. 67). What, then, was the reason of his letter? Mr. Hopkins objects to my objection to the use of delta for inches, that a similar objection would apply to the use of I for inch. If Mr. B. J. Hopkins will refer to my note again, he will see that I merely asked if ft. and in. *must* be discarded, why should not F and I do, instead of pi and delta? I have not suggested their use, but I can assure Mr. B. J. Hopkins that the risk of I appearing as 1 is very small, as in all my experience I never knew anyone write the figure 1 and the capital I in such a manner that there could be any doubt. With regard to the use of the apostrophe placed sideways, it is almost as objectionable as pi, for if the ordinary "stamp" is used it will involve "justification," and if special types are cast that will be two extra in an already crowded pair of cases. I wish your readers to understand that the use of any character not to be found in the usual pair of cases involves, first, the trouble the compositor has to go and fetch it; and, secondly, the great risk that it will never be returned to its proper "box." In a paper such as the "E. M.," all mathematical matter is usually put into the charge of one compositor, and he takes care to look after his "sorts"; but ft. and in. occur all over its pages, and if pi and delta are to be used, they will very soon run short. There is not the slightest objection to "Assoc. M.Inst.C.E.," using "minute marks" to indicate ft. and in., or anything else, if he will kindly append a "mem." to his copy that they are to be printed ft. and in.—that is when they are to appear in a paper like this. Another thing I may mention: Greek characters are usually kept in what I may term the "aliquot" founts; it would be a great nuisance for a printer to be compelled to keep Greek characters cast on every size type he may have in his office. **A Practical Printer.**

A Mr. Starbuck, agent for a railway at Portland, on the Pacific coast, required to send a quantity of iron rails and rolling stock to that place from one of the Eastern States. The freight by rail was estimated for him at £30,000. He obtained estimates for an iron sailing ship to take the goods round by sea, and found that it would be built for £25,000.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51064.]—**Soldering.**—In reply to E. T. Scott's criticism, may I refer him to my two answers to this query, which, taken together, will not, I think, bear the construction he places upon them? I am quite well aware that oil is commonly used as a flux in soldering planished tin goods, on account of the required neatness of the finished work, but for most other metals soldering fluid is certainly better, and if this is applied to a greasy surface the result will probably be as described.—R. T. Lewis.

[51064.]—**Soldering.**—With reference to E. T. Scott's letter on page 91, I would observe that his use of the word "metal" is vague. He ought to have stated what particular metal he alludes to, because I take it that the *rationale* of soldering, also of welding and of brazing metals, is that first there must be surfaces free from oxidation or any foreign body which would prevent absolute contact; and then there must be a "flux," that is something which melts somewhat sooner than the metal which is to be melted, and thus protects it from the influence of the oxygen of the atmosphere. Thus it appears that these aforesaid methods of uniting metals could be effected in vacuo without the necessity for using any flux. Now, I have always found that tallow, which melts at a low temperature and is a suitable flux for lead, may, at a pinch be used also for tinned ware and even for copper; but for these two latter rosin is preferable. But as iron, steel, or brass requires a higher heat to solder, chloride of zinc is necessary. If to braze, a still higher heat, so borax comes into play, and to weld still higher, and sand containing silica is used, which covers the oxidating iron with a fluid glass. Grease would be burnt away at the heat required to solder iron; but I opine that R. T. Lewis allowed paraffin oil to come in contact with his work; even rubbing the copper bit with a smooth file that ever had any paraffin applied to it will make it extremely difficult to make a sound joint.—A., Liverpool.

[51203.]—**Music.**—On looking over some back numbers before sending them to the binders, I notice that I have omitted to reply to the request of "G. F. H." on page 559; but I do not know that I can add anything very material by way of "elucidating" what has already been stated. We are informed by works on harmony that consecutive octaves and fifths are very unpleasant, and, therefore, must not be used. My comment upon this was to call attention to the fact that consecutive progressions of all sorts, but more especially octaves and fifths, were constantly used on organs. When we play "full to fifteenth" (which is so useful a combination of stops that there is generally a composition pedal to control it) the principal and fifteenth give consecutive octaves with the foundation stops, and with each other; and the twelfth yields consecutive fifths with the principal and consecutive fourths with the fifteenth. All these progressions are forbidden by the rules, but the result of them (the progressions, not the rules), is very good. If we add the mixtures, we get a lot more of the objectionable intervals, and yet the result is exceedingly satisfactory. There seems to me, therefore, to be something wrong about the rules. I hope I have made my point clear to "G. F. H.," and must apologise for not having written sooner.—William John Grey, Elswick Science School.

[51313.]—**Power of a Wind Fan.**—I am sorry I did not see "T. P.'s" remarks on my query in time to write last week. I am sorry also I did not make myself sufficiently intelligible to elicit a reply at once. The reason was I wished to be as brief as possible, so as not to occupy too much space in the journal. Although I have not the pen of a ready writer, I will endeavour to be as explicit as possible in putting my question afresh, and I will put it hypothetically. Suppose I wish to fill a vessel with compressed air, and wish to use a *fan* instead of an *air-pump*, what compression could I obtain, stated in lbs. on a pressure gauge? The size and cost of a fan passing 200,000 cubic feet per hour, and whose is the best?—Ignoramus.

[51317.]—**Hand Punching Machine for Nuts.**—As I understand your querist now, he wants to punch the nuts out of sheet, not merely punch a hole through the nuts. I suppose it can be done, but I do not know of any machine for doing it by hand.—Essar.

[51346.]—**Clarionet.**—In reply to "Solus," I privately asked "Old Blow Hard" to contribute a few papers on the construction of clarionets, but I regret to say he has declined. Therefore I will now try to oblige "J. J. D.," and others interested, by sending all particulars as soon as I can, both for C and B flat Albert clarionets, although I would have wished it to come from a more competent source.—Vulcanite.

[51346.]—**Clarionet.**—"Solus" would like working drawings. These I am not able to give, or I would gladly oblige. I gave my mode of procedure on p. 68. I am not aware that the fittings, &c., can be bought ready made. Mine are made from German silver—wire for keys, pillars, &c., and plate for cups, rings, &c. Unless a C or an A clarionet is wanted for orchestral playing, I should advise you to make a B flat. When piano and clarionet play together, it is generally the case that the piano accompanies the clarionet, the clarionet part being written for B flat instrument, and needs no transposition.—Old Blow Hard.

[51346.]—**Clarionet.**—I find that I did not write what I meant in my letter on page 91, as I did not mean to express that "Vulcanite's" scale would make each hole at the same distance from its neighbour; but that it does make them in positions which are not those to be found in wind instruments (that is going in a regular mathematical progression), and to prove my position I append careful measurement of a C clarionet by Button and Co., of London, now in my hands, but unfortunately wanting the mouthpiece; these are taken from place where it is attached. (I may observe that as the reeds as purchased are $2\frac{1}{4}$in. long, it is not likely that the full bore is carried up to $1\frac{1}{4}$in. of tip, as stated by "Vulcanite" on same page.) I may also say that I am not aware that I recommended anyone to make clarionet's of spruce, but merely stated that it answered very well for experimenting on, and if left a little stouter than a boxwood one and French polished, looks just as well. Measurement of a "Button and Co., London," C clarionet:—Diam. of bore, $\frac{9}{16}$in.; total length from where the mouthpiece is attached to end of bell, $21\frac{1}{4}$in.; bell, $3\frac{3}{4}$in.; distance of first valve hole from where mouthpiece attaches, $2\frac{13}{16}$in.; second, $3\frac{13}{16}$in.; third, $4\frac{7}{16}$in.; thumb hole, $5\frac{11}{16}$in.; first finger hole, $6\frac{1}{4}$in.; second, $7\frac{1}{4}$in.; third, $8\frac{5}{16}$in.; fourth, $9\frac{3}{8}$in.; fifth, 11in.; sixth, $12\frac{1}{16}$in.; seventh, $13\frac{1}{4}$in.; first valve hole, $13\frac{13}{16}$in.; second, 15in.; third, $16\frac{9}{16}$in. This last remains open, unless the valve be pressed.—A., Liverpool.

[51431.]—**Legal—Slaughterhouse.**—The only way to put a stop to this nuisance is to take legal proceedings, and before doing that it would be advisable to consult a solicitor.—A Limb.

[51432.]—**Clarionet or Oboe.**—Have only now returned home from holiday tour, or would have replied earlier to queries of "P." and "E. T. S.," page 43. (1) I procure reeds (shaped only) through local music dealers: I think they order them from Lafleur's. I usually order three or four dozen at a time; never trouble myself about this or any other year's growth. I find that on an average 20 or 30 per cent. turn out serviceable; this satisfies me, as they are only 2d. each. If any appear very dry or brittle, I let them float for a quarter of an hour or so in lukewarm water, in addition to keeping them turning about in my mouth while getting silk and wax, &c., ready. I never now attempt to do anything with very narrow or light coloured reeds, but pitch them away at once as utterly useless for my purpose. I rarely fail to get a good soft drawing-room tone. Most undoubtedly the proper way is to get a regular fit out of reed-making plant, and so be in a position to carefully select and shape the cane for oneself; but this costs a lot of money, and I have never cared to incur the expense. (2) I can assure "E. T. S." that so far as I am concerned, oboe playing does not appear to have injured my health in any way. I know the instrument somehow bears an evil reputation, because when I first contemplated going in for it friends and well-wishers (?) foretold my early death by galloping consumption, and that my hair (what was left of it) would first turn grey, and then be brought with sorrow to the grave, &c., &c., and much more to the same effect, *ad nauseam*. However, here I am now at all events, as jolly as ever; I must, nevertheless, admit that in the early stages I frequently experienced a most unpleasant tight sensation round the head, with a disagreeable throbbing of the temples, unquestionably the result of too protracted blowing; but I have not felt such a thing for years, although, perhaps, occasionally blowing four hours at a stretch at musical evenings. I am unable to say whether the above killed Barry, or any other player; but I think that wind instruments, by no means confined to the oboe, might, with persons of peculiar physical conformity, &c., bring about death. As regards the small aperture of the staple permitting so little wind to pass in a given time, I am inclined to the opinion that just as much breath is expended in playing a piece on the oboe as on the soprano cornet. I am open to correction on satisfactory proof, but I shall stick to that opinion until I get the satisfactory proof. With respect to mastery of the reed, the time may vary between one month and ten years, or never. I know a gentleman, a most clever mathematician and linguist, who has never yet mastered the operation of cutting a slice off a loaf of bread. I don't know how long he would be struggling with an oboe reed, but would fix it, at a rough guess, at a little under a century. What the dickens "Vulcanite" means by the last four lines of his letter on page 69 I am utterly unable to comprehend; he has played oboe and clarionet alternately for the last dozen years, and yet says: "It (i.e., oboe) is done the same as an ordinary chemical blowpipe, &c., &c. I don't know which to pity most, the "alternately" or "the last dozen years." I never heard of the oboe being played from anything else than the throat and chest; in fact, the reed, from its very delicacy and skittishness, requires that large elastic reservoir of compressed air behind it for its proper performance, and any attempt (with me) to produce a note from the compression of the cheeks alone (if this is what the blowpipe allusion means) results in a short, coarse, "squaak," just like a squeaking toy animal. I really must shake my head and smile seriously at "Vulcanite"; but no offence, you know—all in good part.—O.

[51436.]—**Drainage.**—Your correspondent "An Inspector" should try the addition of plaster and coal oil to the cement he speaks of. But, in truth, the use of any cement at all shows the absurdity of the present blundering systems of drainage. Your correspondent should use iron pipes, and make his joints with lead in the usual way. If he should say that he never heard of drainpipes being made of iron, which is not unlikely, I can only say that he should make inquiry at Oxford, Westminster, Bagshot, Claremont, and other places where some sewage arrangements have been placed under the care of really competent engineers.—Nun. Dor.

[51439.]—**Photography on Wood.**—Premising that I know nothing practically about the matter, I may say that I believe the carbon process is used for the purpose, a tissue containing a maximum of colouring matter and a minimum of gelatine being selected by preference. Instruction and materials may be obtained from the Autotype Company. I have not heard of the powder process being used, and should doubt whether it would give clear enough impressions.—W. Robinson, Jun.

[51448.]—**Ebonising Cabinet.**—Almost as a matter of course, "Ignoramus" forgets to mention what wood he intends to use; but he will find plenty of recipes for ebonising in back numbers. The usual stuff is first deep staining with decoction of logwood, and then sulphate of iron solution. Add a little Prussian blue to the polish.—Nun. Dor.

[51450.]—**Glass Globes.**—I believe these glass globes are coloured by running into them, whilst still hot, a little amalgam of the colour required. For silver, I believe it is lead, tin, and bismuth 1oz. each, and quicksilver 4oz. Probably some of your readers can give more particulars.—Nun. Dor.

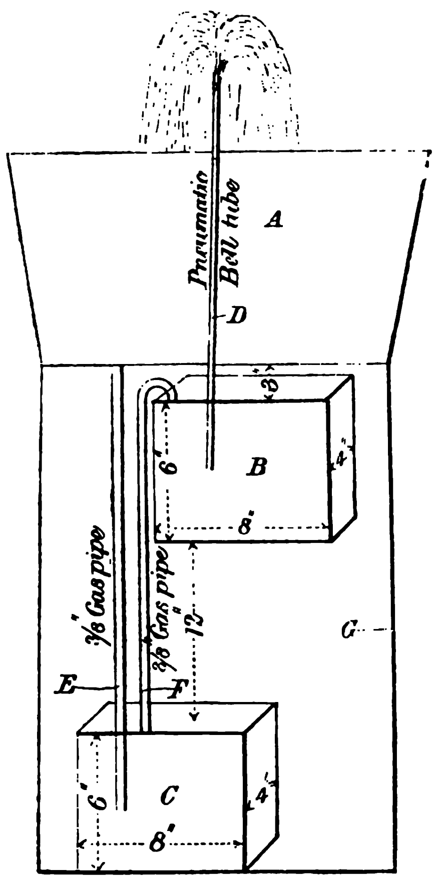
[51452.]—**Gelatine Emulsion for Slow Plates.**—Try the following:—Water 1oz., bromide of ammonium 10gr., nitrate of silver 15gr., gelatine 20 to 30gr. Take one-fourth the total quantity of water, dissolve in it the bromide of ammonium, and put the gelatine in to soak for an hour or so. Also dissolve the silver nitrate in another fourth of the water. Then melt the gelatine by putting the vessel containing it in a pan of boiling water, pour in the silver solution, keeping the mixture well stirred with a glass rod. Take out of the hot water and allow to set. Then break up and wash by any of the usual methods, dissolve, make up the bulk with water if sufficient has not been absorbed during the washing process, and coat your plates.—W. Robinson, Jun.

[51474.]—**Cuttings of Tinplate.**—Does not Mr. Milne know that several patents have been obtained for methods of utilising cuttings of tinplate? If he looks through the indices of back volumes, I am sure he will find a good deal of information on the subject; but any really profitable process is patented.—Nun. Dor.

[51491.]—**Hot-air Engine Patents.**—This query should have been sent to a patent agent, who, for a small fee would have supplied the querist with the information.—Nun. Dor.

[51557.]—**Nickel-Plating.**—If you use the sulphate, the proportion is $\frac{3}{4}$lb. to a gallon, if the nitrate, 9oz. to gallon. The bath should be of specific gravity of 7° Twaddle. I am sorry that I unintentionally misled you about the liquid bisulphite. I meant that you should prepare it at the time, as the solid does not keep, but is gradually converted into the sulphate. To prepare it, make a saturated solution of carbonate of soda, and pass a current of sulphurous acid gas through it until it reddens blue litmus paper. For a six-inch bichromate, zinc and carbon plates of about $2\frac{1}{2}$ to 3 inches surface. If they are kept going continuously all day, it is better to recharge them next day to the extent of emptying away the two liquids and adding fresh water and sulphuric acid. Of course you would keep a stock of crystals of bichromate in the carbon cell, which would not want renewing. It is better to use pure nitric acid; the red gas you notice is nitric oxide. It is better to crystallise and make sure of getting rid of all the acid used. The crystals are deliquescent and liquefy if left in the air. The dark colour may be caused by too rapid deposition or by an impure anode. You will find that the nickel will be deposited much better and whiter if you add a small quantity of boracic acid to the bath. In fact, an excellent solution is made by the sulphate and boracic acid alone.—E. A. H.

[51577.]—**Rushton's Self-Acting Fountain.**—I inclose sketch of a self-acting fountain, given me by a friend that has got one going very well; but I do not know if it is Rushton's or not. A is a cistern or tank to hold about one gallon of water; B and C are air-tight cisterns, 8in. by 6in. by 4in., with pipes soldered in, as shown in sketch; D is a piece of pneumatic bell tube; E and F are pieces of ⅜in. compo. gas tube; and G is a case or pedestal to contain the cisterns. The jet must be very small, or it will not work. To set it in motion, fill A with water till it charges C. The water then rises in F, and fills B about half-full; then blow in the jet to get a pressure of air in the top part of B. The air then forces the water up D and out of the jet, which falls into A; keep A about three-parts full. Hope this will suit "Chemicus." The pipes E and D must be kept about half-way from the top of B and C.—G. T. D.



[51580.]—**Model Boat and Incandescent Lamp.**—Trouvé's solution has been given, Vol. XXXVII., p. 180; it cannot be too well known, 3oz. bichromate of potash, 9oz., or, say, ½lb. sulphuric acid, and 1 pint water. If the bichromate is powdered, you may use 4oz. and 10oz. acid. It is most powerful when warm. The zinc must be amalgamated. A five-power lamp will require four to seven cells in series. The lamps do not all take the same current: it depends on the connections and thickness of the carbon filament. It is best to have plenty of power in the battery, otherwise the light soon becomes feeble. The smallest size plates I would advise are two carbons 6in. by 2¼in., and one zinc plate, 5in. by 2in. The zinc should be 1in. or more distant from each of the carbon plates, and if you mount a series of six sets on a sliding frame and use cells containing each one quart or three pints of solution, you will get a light equal, or, perhaps, a little better than a common mould candle; but you will find it satisfactory.—J. Sutcliffe.

[51592.]—**Utilising Vegetable Fibre.**—If "Nicaragua" will advertise name and address we shall be pleased to reply to his inquiry.—Death and Ellwood, 20, Bucklersbury, E.C.

[51630.]—**Organ Pipes.**—"G. R. T." (p. 45) wishes to make pipes for an organ with 1½ row, and of 8ft. tone. As it is to be of 5-octave compass, he should make the pipe for the lowest bass note C, 8ft. long, that is, if it is intended to be an *open pipe. If a stopped diapason is required, the pipe for this note should be about half the length,* viz., 4ft. If all open pipes are required, the second C from the bass should be 4ft. in length, and the third C 2ft., and so on in proportion with all the C's. The half row may be made a stopped wood pipe, if preferred to an open one. You can buy these pipes cheap enough, and so save the trouble of making them. This would be the most satisfactory plan to adopt if you have never made any pipes before, which, judging by the wording of the query, I should conclude you have not. By reference to back volumes you will find all the necessary information you will require with regard to the scale of the different pipes.—G. Fryer.

[51638.]—**Lathe.**—To W. W. Evers.—I have a friend that will do the boring and turning if I could inform him how to do them; therefore I should be obliged for particulars how to fit the head and tail stock up. My lathe head is for cone bearings and back gear. How are gear wheels, cone pulley, &c., made fast?—Miner.

[51639.]—**Gelatine, to keep.**—Various substances will be this—e.g. carbolic, salicylic, or glacial acetic acids. I do not know about restoring the elasticity, but it may be prevented becoming brittle by the addition of more or less glycerine or treacle.—W. Robinson, Jun.

[51646.]—**Straightening Fine-Gauge Bottling Wire.**—First get a steel plate with holes drilled through in a zigzag form—say, 13 holes, six on each side, forming two lines, leaving a distance between these lines for the wire to pass between two rows of iron pins, which must be driven into the holes; the wire to be pressed to the surface of the plate by a piece of leather; the whole to be fixed upon a block of wood. Secondly, get a wooden drum to rest the coil upon, and run the wire on through the pins to a large cylinder, say 4ft. wide. Cut the bow thus made right through, taking one end and cutting the whole into lengths as required. The straightening plates can be had of the writer.—James Mitchell, wire gauge and dressing-plate maker, High Roadwell, Halifax.

[51648.]—**Sensitising Linen.**—Float on a solution of gelatine or albumen containing about 10gr. per oz. of common salt, allow to dry, and sensitise by floating on a 60gr. solution of silver nitrate.—W. Robinson, Jun.

[51656.]—**G.W. Engines.**—The letter "S" painted on the engine lamps of this company means "Special"; that is to say, when the engine is drawing a special train, the lamp is turned so as to exibit the S; and when it draws an ordinary train, it exhibits a small white, diamond painted on the other side of the lamp. The two white diamonds painted on the buffer beams of engines signify that they are the property of this company; this being their "stock mark," with which most of their carriages and trucks are marked; as also are their signal levers, and I believe all their telegraph instruments.—Machina.

[51679.]—**Indiarubber Gaspipe.**—I have used a Fletcher table stove some years, and have bought his special tube, yet have never succeeded in avoiding smell from an uncovered tube. However, I have succeeded in covering a tube so that it has lasted free from smell 1¾ year, by giving it a good coat of hot glue, and lapping it with woollen braid while wet. I have tried two coats of copal varnish, but it does not answer as well as the glue.—Emeritus.

[51685.]—**Loose Teeth.**—In playing the flute there is no occasion for such violent pressure as you mention. W. S. Rockstro, one of the best authorities, says:—"The flute should be pressed firmly, but not violently, against the centre of the lower lip. It is most important that this pressure should be steadily and equally maintained. It should be just sufficient to keep the lip close against the teeth." I have played the flute (for amusement only) for the last 25 years, and my bottom teeth are as firm as ever. To harden the gums and keep the teeth in the best order, use only common salt for a dentifrice. After the first unpleasantness is got over, it is really surprising how refreshing it is, and what a healthy state of teeth and gums it causes.—J. E. A.

[51690.]—**Metaphysics.**—Your correspondent "F.R.A.S.," in reply to query, English Mech., Sept. 28, appears to hold an opinion with regard to the nature of metaphysics which could be of but little service to the inquirer whose question he undertakes to answer. I fear that neither of the books which he recommends would be of use to a serious student of philosophy, inasmuch as all four are written with the express purpose of showing that such a thing as philosophy (or that department of it which is termed metaphysics) has no existence. With regard to any positive philosophical view held by the writers of the works mentioned, it is quite indifferent as to whether "T. H." is enabled to contemplate "the larger circle, which includes both subject and object" (Lewes), or whether he adopts Huxley's alternation of materialism and subjective idealism; or, failing these, whether he feels himself called upon to agree with Bain and Comte, who do not trouble themselves with metaphysic at all. He will derive (if we except the pearls of fact which are strung upon these theories) about equal enlightenment from each. If, however, he should recognise, as he apparently does, the necessity for some kind of philosophy, and also that the explanations which constitute it should begin with a perfectly adequate and consistent theory of knowledge, there is no better book to begin with than Kant's "Critique of Pure Reason" (Bohn's ed.), to be read in conjunction with an exposition such as that of Prof. Adamson (David Douglas), or the larger work of Prof. Caird, of Glasgow. It would be beyond the limits of this reply to discuss the value of metaphysics in relation, not only to science, but to everyday life. The remark, however, may be made, that those who speak about "logomachy" in philosophy may possibly fail to remember that a similar phenomenon has exhibited itself in the early growth of every other science. Whatever wordy warfare over metaphysical problems may exist at present is quite probably due to the—self-constituted—friends of science, whose procedure, though based upon strictly inductive principles, generally involves them in metaphysical speculations of an extremely questionable nature.—Alfred Stapley.

[51694.]—**Lawn Tennis Court.**—I am greatly obliged to "K. W." and "Semper Fidelis" for their replies to my inquiry respecting the covering of concrete for a lawn tennis court. In reply to the latter, I cannot say what the intention of the owner was, who is now dead, and the property has twice changed hands. The idea of jagging up the concrete and covering with a fine layer appears to me what is required; but what material should it be composed of, that would only cost £15 for 4in. in depth, and would stand the weather.—H. B.

[51696.]—**Royal Arms.**—I do not think the courts will have much difficulty in deciding the question of intention to deceive. The very fact that a man uses the royal arms on his billheads or cards is impliedly an intention to deceive when he has no authority for their use. I have no doubt that the fine, when inflicted, will be very small—on the first conviction that is. As to those who have hundreds of pounds' worth of labels with the Royal Arms on, if they have any right to put them on there will be an end of the matter; if they have not, they will meet with their just deserts in being compelled to sacrifice them; for a tradesman who would be guilty of seeking to increase his business by leading the public to believe that he carries it on under royal patronage when such is not the fact, deserves no pity, but rather kicks.—N. E. Child.

[51698.]—**An Excellent Yeast.**—Take 4oz. hops, ½lb. brown sugar, 4qts. water, 2 tablespoons of salt, 1lb. best flour. On Monday, boil hops for 20 minutes, strain, and let rest to blood heat. Then mix sugar, salt, and flour in a pint of what is boiled, blend, and pour back into the water. Cover and put into a close place, or by the fireside. Mind, don't let the temperature be too high. Stir often during the day and always keep covered. On Wednesday add 3½lb. potatoes mashed up. Let all stand until Thursday evening, then bottle and secure the corks. My cook has dictated the above, and has used this yeast with the greatest success for the last five years. Should you not succeed in your first attempt, persevere—it is worth the labour. It makes excellent bread, and lasts as long as you care for. If "E. R. D." wants more information let him advertise his address.—Barley Bread.

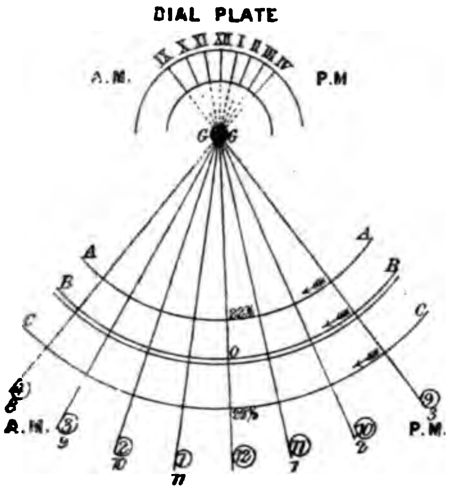
[51700.]—**Smoke Nuisance.**—The only way to prevent black smoke from issuing from chimney tops is by having sufficient grate area for the work to be done, so as to allow easy firing when side firing, or front and back alternate firing can be resorted to. There is a great difference found in different coals, furnaces, and men to put the coals on. What are the fires doing which "Garnet" inquires about? Are they steam boilers, furnaces, kilns, or are they pushed or working easy? If "Garnet" will advertise for a smoke-consuming apparatus, no doubt he will hear of about one hundred or more, but I have not yet met one which would entirely consume the smoke, which I think cannot be done in all-round practical working. If a good stoker has sufficient grate area he can prevent black smoke (which is a sure indication of waste), the smoke being of a light brown, and not approaching a nuisance.—Boswell.

[51700.]—**Smoke Nuisance.**—A great deal depends on the stoking; it is a bad plan to fire up on all the fires one after the other; much smoke may be prevented by firing alternately; also by putting the coals on in the front of the furnace, and when well alight, lightly push them to the bridge evenly with the rake upside down, so as not to disturb the under fire more than necessary; the dampers should be lowered a little when the coals are first put on till the coals blaze; this will frighten some stokers, who throw the coals on anyhow; the steam ought to be watched, and the coals put on when it is on the rise; but system is the main thing—that is, if the boilers are masters of the work they are doing. If "Garnet" will give me his address, I will give him a sketch of something that will prevent a lot of smoke. I have never seen a perfect smoke consumer: a lot of these so call "smoke consumers" are only so called.—Old NaCl.

[51701.]—**Levelling Slab.**—The querist must be under some misconception as to this, nothing of the sort being requisite for toning prints.—W. Robinson, Jun.

[51702.]—**The Herb Cure-All.**—The "vegetable" which "kind Providence has planted in our gardens," and which "The Kent Hermit" (p. 488, No. 957) says "will cure every known disease," and make the man of 75 as nimble on his pins as if he were only 17, is the herb Cure-All (*Atropa quackensis*), which can be found only by Unblushing Effrontery when accompanied by Inconceivable Ignorance.—N. E. Child.

[51705.]—**Sundial.**—The sun is in its June or north circuit at A A, in March and September at D D, and in its December or southern circuit at C C. G G is the gnomon of the sundial, placed in



any latitude north of the Equator. As the sun revolves from east to west, and uninterrupted by any clouds, it throws the shadow of the gnomon on the dial-plate, in the exactly opposite direction, no matter what the season of the year may be. In the June solstice, its speed per hour is 562½ miles; on the Equator, 900 miles; and in its December circuit, 1,237½ miles; so that the shadow on the gnomon never varies its direction, be the sun's speed what it may. The nearer to the northern centre the more complete is the circuit of the shadow on the dial-plate. And while in the December or southern circuit it only shows eight hours, in the June or northern circuit, it shows sixteen hours of the day in well-exposed situations. The principle of the sundial is the most simple of all instruments, and was probably the first philosophical instrument ever made by the hand of man. The motion of the sun is spiral or eccentric for 360 days, and concentric for 2½ days, or 60 hours, at each solstice. Its much slower progress in its northern circuits, of course, accounts for the greater heat we then experience. In the winter or southern orbits, its much greater rapidity of motion considerably reduces the temperature. If any impartial reader will only study the wonderful simplicity and extraordinary harmony of the sun's courses from east to west and from north to south, he will feel ashamed at the idea of a revolving earth and a motionless sun. There is much more to be said about it; and when public prejudice against it somewhat abates, I shall not feel I am trespassing on the indulgence of the Editor, as I do now.—John Hampden.

[51714.]—**Removing Ink.**—You can remove the ink completely by a strong solution of oxalic acid.—E. A. H.

[51714.]—**Removing Ink.**—The usual recipe for removing ink is a hot solution of oxalic acid, bleaching afterwards with a little weak solution of chloride of lime. As it is gelatine, you must try the acid cool. Crush it to powder, and put it on the part, then moisten with just warm water, and when the black colour is discharged wash off with cold water.—Nun. Dor.

[51715.]—**Fluorspar.**—Fluorspar is largely used as a flux in metallurgical operations. It is not used in the manufacture of glass; but its chief use is in the preparation of hydrofluoric acid for etching glass. It is easily tested (1) by heating it in the dark, when it emits a phosphorescent light, provided it has not been heated before; (2) by pounding some up and mixing with sulphuric acid in a leaden dish, placing a piece of glass over the dish as a cover, and heating, when the glass will be etched. If the substance is quartz, the sulphuric acid will have no action whatever on it.—E. A. H.

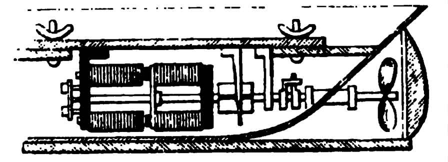
[51716.]—**Street Lighting.**—In answer to "Luminous," the principal regulating burners suitable for street lamps are:—Borrodaile's, 2s. 6d.; Peebles', 1s. 6d.; Snelgrove's, 1s. 3d.; Sugg's, 2s. 6d. These prices would be the ordinary governor burner; but if fitted with long necks about 6d. each extra. The sizes usually used are 4 or 5. The make of burner is a matter of choice and expense, there being practically little or no difference in their efficiency. With regard to reflectors, I cannot well recommend their use for street lamps, as they simply concentrate the light at the expense of distribution.—Gas Engineer.

[51718.]—**Outdoor Officers of Customs.**—All successful competitors for outdoor officerships in the Customs are admitted to the Service as Outdoor Officers of the *second* class, at a salary of £55, increasing to £80 by annual increments of £1 10s. They may be promoted at any time to the *first* class to a salary of £85, increasing to £100 by annual increment of £1 10s. No examination is necessary to get from the second to the first class.—L. E.

[51719.]—**Water Motors.**—The rule to calculate the quantity of water which will run through a borehole or pipe is as follows:—Let P = pressure in feet, d = diameter, l = length, and V velocity in feet per minute, then $V = 2837{\cdot}5 \sqrt{Pd} / l$, and $525\,V \times {\cdot}7854d^2$ = gallons of water per minute.—G. Worland.

[51720.]—**Electric Launch.**—Certainly, with pleasure. An electric launch 2ft. long. You have nothing to do but to reduce the dimensions given on p. 389, last volume, to the size required. Where do you propose to carry the battery and motor? It will not be easy to get them into the boat.—Nun. Dor.

[51720.]—**Electric Launch.**—A model 2ft. to 2ft. 6in. long should have 6in. to 7in. beam, the depth 4in., and be about 2½in. deep in the water. The hull can be made either in wood or tinplate, but it should not weigh more than 3lb., or else it will be too heavy to carry the engine and battery. In the drawing, the propeller shaft is passed through a tube in the stern; this tube has a stuffing box to prevent water entering. The engine shaft has a flat plate at the end with a pin fixed in it, which works the propeller by a wire catch. The engine itself is built on a baseboard fastened to the deck by two screws with wing nuts in order that it may be easily removed for adjustment. One of the electro-magnets shown revolves on the shaft; its poles are reversed by a split ring commutator, which is set close to the magnet. The other magnet is fastened to the baseboard; this magnet has a hole in which one end of the revolving shaft runs; the other end works through a brass bearing piece, which is also fixed to the baseboard. The magnets should be round iron $\frac{3}{16}$in. diameter, and the propeller may be 2in. or more. Two small Groves or bichromate cells should drive the engine. The battery is not shown; it should be placed in the fore part of the boat.—J. Sutcliffe.



[51722.]—**Prevention of Rust in Firearms.**—The following composition will keep firearms from rusting for months: Dissolve ½oz. of camphor in 1lb. of hog's lard; take off the scum, and mix as much blacklead as will give it an iron colour. Rub the steel all over with this, and leave it on for 24 hours, and then rub with a linen cloth.—E. A. H.

[51724.]—**Height of Barometer.**—29·76 in last line should read 29·74.—M.M.I.Sc.S.

[51724.]—**Height of Barometer.**—The barometrical readings as published in the newspapers are generally reduced to sea level, and a barometer falls $\frac{1}{10}$ of an inch for every 90ft. of elevation, so that when the *Telegraph* gives 30in., your aneroid should read 29·74in.—G. Worland.

[51728.]—**Photography.**—Rather too much nitric acid for so small a bath; formula otherwise all right. Smears probably owing to dirty plates, which should be "chemically" clean, not merely so in appearance. Cyanide of potassium will dissolve the image if proper care be not taken; but I never knew hypo. to do so.—W. Robinson, Jun.

[51732.]—**Crystoleum.**—A paste made of arrowroot is an excellent material for fixing the photo to glass. When you have fixed on the glass, at once proceed to scrape it with a flat piece of wood until all the air bubbles, lumps, and "snail marks" have disappeared. Then put it to dry, and when dry, rub as much of the paper off with sandpaper as you can. Then render it transparent by the following varnish. Canada balsam 2oz., turpentine 1oz., linseed oil 2oz. Let it soak thoroughly in for 24 hours, then wipe dry with a cloth, and then brush it over with spirit mastic varnish—made by dissolving 1oz. of gum mastic in 3oz. of turpentine—or else with copal varnish, and let it dry; and then it is ready for painting.—E. A. H.

[51733.]—**Retouching Negatives.**—Capital article on retouching and varnishing negatives in No. 853, p. 496. On. p. 366, No. 796, you will find an article thus headed, "Negative Retouching for Amateurs," which ought to supply you with all the information needed.—Nun. Dor.

[51734.]—**Scum Cock.**—The proper height for scum cock (?) (trough, I presume is meant) is at the working level. There are many kinds of troughs or collectors in boilers, several of which are patents. The one meeting most favour is the side trough (not a patent), which extends along one side of boiler; it is V-shape in section, the bottom being perforated, the perforations being passages from trough to pipe, which passes from boiler at front end generally, the front end being most convenient for use. Scum troughs are not generally put in new boilers now unless specially asked for, as they are considered of little use, except in special cases, such as a very light sediment forming, and they are always in the way of cleaning.—Boswell.

[51737.]—**Engineering.**—The colleges or institutions at which youths are grounded in engineering work are not intended to supersede the practice of serving five years or less in engineering shops, but are intended to prepare youths to learn more fully during their apprenticeship. The mere passing of a course at one of these institutions is of little value unless backed up by practical work. There is little change in the system pursued at the works of our largest railway companies: either a premium must be paid or the youth must work his way up step by step, unless he has other influence to help him. The best thing for "X. Y. Z." to do depends upon circumstances; but a youth not afraid to work with capital and influence at his back cannot help but succeed, and if he lacks any of these he will have to make the best of what he does possess.—G. Worland.

[51738.]—**Laundry Stove.**—One is as good as the other; if you regulate the draught with a damper just let sufficient air through to carry off the smoke after the fire is well alight.—Old NaCl.

[51741.]—**Fixing Pipes to Harmonium.**—The pipes can be fixed to the harmonium by glue, nails, or screws; but I am afraid that is not what your correspondent means. If our friend has a genuine harmonium by Alexandre, if he will take my advice he will let it alone, and not attempt to stick so much as one pipe on it. If he wanted to preserve carbonate of ammonia, would he steep it in sulphuric acid? The one is just as feasible as the other.—N. E. Child.

[51750.]—**Washing Negatives.**—No definite rule can be laid down, much depending upon circumstances; better, however, err on the safe side than find your negatives fading out—that is, if you want them to keep.—W. Robinson, Jun.

[51751.]—**Harmonograph.**—What you call the pendulograph is most likely the harmonograph or sympalmograph. See pp. 18, 93, Vol. XXV. Search the indices under those heads and "Lissajous' Figures." On the pages given there are illustrations of the apparatus.—N. E. Child.

[51753.]—**Sugar, Agent in Decolorising.**—Animal charcoal has the property of condensing or forming a loose combination with oxygen from the atmosphere, and in contact with the colouring matter it gives up this oxygen in a nascent condition, and so oxidises the colouring matter to colourless compounds.—E. A. H.

[51753.]—**Sugar, Agent in Decolorising.**—Watts, "Dictionary of Chemistry," p. 702, says that "Wood charcoal and animal charcoal have the power of forming insoluble compounds, especially with organic colouring matters. . . . The peculiar power of bone-black in removing colouring matters from solution is due to the more minute division of the charcoal, resulting from the interposition of the earthy matter."—R. A. R. Bennett.

[51756.]—**Cartridges for Martini-Henry.**—The powder used for loading these cartridges is, I believe, No. 5 or 6 grain; the charge 2½ drachms. About seven years ago, the charge was 3½ drachms; but it was reduced in order to lessen the recoil.—Machina.

[51756.]—**Cartridges for Martini-Henry.**—My best thanks are due to "Eccentric" and Mr. W. J. Grey. I have not used the black powder because I am told that the rifle "kicks" so heavily with it. If not troubling "Eccentric" too much, would he explain the mode of loading (I have the shells already capped). I do not understand what weight to use, whether troy or avoirdupois, having always been accustomed to measure powder for my shot gun in drachms: also about the wads, and where used, as a Government cartridge that I pulled to pieces had no wad under the ball, and are doubly patched.—Thos. H. Hall.

[51757.]—**Bradford's Washing Machinery.**—"Washerman" is somewhat severe on "One in a Fix." Possibly the latter has been "done" with his secondhand machine. If it is really Bradford's make, it will want very little repairing, unless, of course, it is totally worn out, or has been accidentally injured. If "One in a Fix" will advertise his address in "ours," I will do my best to assist him to put it right.—W. M.

[51767.]—**Continuous Brakes.**—The train that "Historian" saw at King's-cross was no doubt a District train; the brakes are a kind of Westinghouse, but I believe they are not automatic. There is only one brake, and until lately the pipes were coupled up, as on the Metropolitan trains. There is a valve at the end of each pipe, and when the pipes are connected the valves open, and when the pipes are unconnected the valves are closed.—T. M. R.

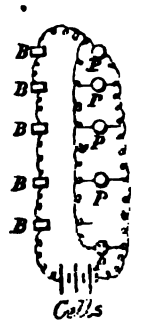
[51769.]—**Links in the Brake History.**—The first continuous brake (that is the first system intended to apply retarding force to each vehicle in the train) was invented by George Stephenson as long ago as 1832; it acted through the medium of the buffer-rods, and was put in operation as soon as the train received a check from steam being shut off and the tender hand-brake being applied. Some of the vehicles were fitted with brake-blocks to press against the wheels, others with sledge-brakes to press on the rails. After trials had been made on the Liverpool and Manchester, and Leicester and Swannington Railways, it was found that this brake could not act on the rear vehicles of trains, and it appears to have been abandoned in consequence of backing the train. The first steam brake was invented by Robert Stephenson. A patent was issued to him bearing date, at Westminster, 7th October, 1833, No. 6484, and was tried on the Liverpool and Manchester, and Leicester and Swannington Railways. It has always been understood that the object of this powerful *steam brake* was, in the first instance, to give the necessary "check" which was required to bring the *buffer-brake* into action. In reply to the third part of the question, the Westinghouse air-pressure brake was adopted first by the Pennsylvania Railroad, U.S.A., in 1869; it was not until 1872 that it was brought to this country. In the early part of the year 1872 the Caledonian Railway Company fitted a trial train with the air brake and signalling apparatus; on the 15th March it was put into daily working between Glasgow and Wemyss Bay. A very important official trial took place 28th March, 1872. Full details of the brake, and also the results obtained, were published in the English Mechanic at the time, Volume XV. page 295. A very good illustration of the engine (No. 101) as fitted with the brake is given in Dredge's "Pennsylvania Railroad." The Westinghouse automatic brake was invented 1871, tried in America in 1872, and first introduced into this country upon the Midland Railway. This company fitted it to a new train (consisting of engine and tender, No. 134, and fifteen vehicles), which was sent to the celebrated Newark Brake Trials, June 9th to 16th, 1875. At the conclusion of the trials this train was put into regular working between Bedford and London, from July 16th, 1875, to June 3rd, 1876. This became quite a "show train," as engineers from all parts of this country and the Continent rode in it to examine the working of the brake. The engine (134) was illustrated in the English Mechanic, Vol. XXVII. p. 190. I quite agree with your correspondent, "Historian," that certain links in the brake history deserve attention, and ought not to be lost. It will, therefore, give me great pleasure to furnish him with the notes I have taken at various trials, and other information in my possession.—Clement E. Stretton.

[51770.]—**Razor Paste.**—Levigated oxide of tin, prepared putty powder 1oz., powdered oxalic acid ¼oz., powdered gum 20gr.; make into a stiff paste with water, and spread evenly and thinly over strap. Take care to powder them very finely.—E. A. H.

[51778.]—**Steam Flour Mills.**—The power needed for a pair of stones depends, of course, on the quantity of feed passing through them. As a rule, they need 1·11 indicated horse power for every bushel ground per hour. At the mill I am at, our stones need about 18 indicated horse power for each pair.—Alpha.

[51779.]—**Metallic Precipitates.**—Bronze: Add hydrochloric acid, pass sulphuretted hydrogen, black pp. = copper, filtrate, reduce by zinc, dissolve in hydrochloric acid, add mercuric chloride, white pp. zinc; add ammonia and pass sulphuretted hydrogen, white precipitate. Copper is mentioned in the bronze.—W. D.

[51776.]—**Electric Bell.**—If you fit your bells up as shown in the sketch, your battery will not always be in circuit, and you will be able to ring them from any story.—W. D.



[51781.]—**Chemical.**—The ruby-coloured crystals you observe are a double sulphate of chronium and potassium, i.e., chrome alum. They are formed by the double decomposition of the potassium bichromate and the sulphuric acid. The reaction that takes place is: 1. On mixing bichromate solution with sulphuric acid

$$K_2Cr_2O_7 + H_2SO_4 = 2\,CrO_3 + K_2SO_4 + H_2O$$

and then the chromic acid oxidises the hydrogen, which is liberated at the zinc plate when the battery is working, and we get:

$$K_2SO_4 + 2CrO_3 + 3H_2SO_4 + 3H_2 = 6H_2O + 2KCr\,(SO_4)_2.$$

The $KCr\,(SO_4)_2$ being the crystals in question, i.e., chrome alum. The green crystals are chromate of zinc, formed by the action of the chromic acid on the zinc, on account of the liquids diffusing to a certain extent through the porous cell.—E. A. H.

[51785.]—**Electric Tell-Tale.**—In reply to "C. E." we have pleasure in informing him that we have made and supplied a special form of electric tell-tale to different asylums, which records in ink on paper the time the watchman or warder visits a certain station, how long he remained there, where he went to next, and how long he was in going there. One of these instruments has been at work for over two years in the North Riding Asylum, Clifton, near York; and its performance has been very flatteringly spoken of by the Commissioners in Lunacy, by whom it has been recommended.—Harrison, Cox-Walker, and Co.

[51788.]—**Compound Engine.**—If "Compound" will send to the "E.M." the initial pressure, point of cut-off in each cylinder, and number of revolutions per minute, and state whether condensing or not, I will try and help him. The way to get the number of square inches in a cylinder is to square the diameter, and multiply by the decimal number ·7854, which has been given numbers of times in the pages of the English Mechanic. But taking your cylinder, the areas will be 8 × 8 × ·7854 = 50·26in, 14 × 14 × ·7854 = 153·93in.—Fiber, Dewsbury.

[51792.]—**Cancer in the Mouth.**—What authority has "The Kent Hermit," for the statement that "smoking is frequently the cause of cancer in the throat"? I daresay that here and there some medical man with a "bee in his bonnet" would put the cancer down to smoking; but can the "Kent Hermit" find a jury of physicians and surgeons to endorse that dictum? The querist's friend is in all probability suffering from epithelioma, and he must seek the cause in something very different to smoking. Dewsbury is not a great distance from Leeds, and the sufferer should consult the surgeons at the Leeds General Infirmary. If he declines eleemosynary aid, he can consult one of them privately, or can subscribe to the funds of the institution.—Nun. Dor.

[51794.]—**Hardening Spindles.**—Pack them in a piece of iron pipe with animal charcoal, charred leather, hoof clippings, &c. (the first alone will do); heat to a red heat, and leave so for several hours; then turn out into water.—Nun. Dor.

[51794.]—**Hardening Spindles.**—"A. E. M." will find the best way of hardening above is to case-harden them with burnt leather thus: get iron case size he wants, burn some leather, old shoes, or anything he can lay hold of, to a cinder; then collect and crush fine, and put about an inch deep in the bottom of his case; then put spindles in layers, scattering burnt leather between every layer, covering top layer well up. Then put case in fire, heating gradually; let stop in fire about quarter of an hour after blood heat, taking care not to get to a white heat, then plunge out of case into cold water.—H. H.

[51795.]—**Sugar Boiling.**—The cause of your failure is simply this: you do not boil your sugar up to the height of temperature required. A thermometer, as used by sugar-boilers, would, I think, be a very useful instrument for your purpose. I do not know the exact price of them, but they are not very expensive, and with care will last a lifetime. I have seen a good deal done in this line; therefore, I have a good idea as to the cause of your failure.—G. Fryer.

[51800.]—**Measuring Hills.**—For measuring the altitude of hills, I have found a pocket aneroid barometer very useful and sufficiently accurate. You can buy them graduated for heights. Price, I believe, about £5 5s. 0d. Mine shows a difference of 10ft. Of course, if you know the altitude and the size of your tricycle wheel, with the number of revolutions, you can easily find the rate. This method is sufficiently accurate for the ordinary purposes of a pleasure trip.—F. G. A.

[51803.]—**The Portland Vase.**—Miss Meteyard says (p. 596, Vol. II., "Life of Joseph Wedgwood") that it is probable not more than fifty copies were made in Wedgwood's lifetime, and they were not all of an average degree of merit. Nor were they all exactly similar; some of the vases being "made with the white without any blue in it, and some with the yellow white, as different people have different tastes." Miss Meteyard, in a footnote, gives a list of 15 copies of the vase then known to exist. Fifty guineas was the price fixed by Wedgwood. I am afraid that your correspondent's copy is one of the "wholesale piracies" of Wedgwood's finest works, as it seems unlikely that Wedgwood would make smaller copies of the vase; at least, I see no reason why he should.—Nun. Dor.

[51803.]—**The Portland Vase.**—The following facts are gathered from "The Life of Joshua Wedgwood." In April, 1786, the collection of antiquities and articles of *virtu* belonging to the late Duchess of Portland were sold by Messrs. Skinner and Co. In this sale was included the "Barberini" vase, or Portland vase, as it was afterwards called. Wedgwood was determined to buy it at any cost, and bid up to upwards of a thousand pounds. At this stage the then Duke of Portland crossing the room to him asked his object in wishing to possess the vase. On learning the object the Duke offered, if Wedgwood would cease bidding and permit him to become purchaser, to place it in his hands and allow him to keep it sufficiently long to reproduce and do what he required. The copy was in due time produced, and as a *chef d'œuvre* of modern ceramic art, was perfectly unrivalled. Wedgwood produced fifty copies, which were subscribed for at fifty guineas each, but it is said that the sum thus realised (£2,500) fell far short of his actual outlay in making them. One of the first fifty is still in the possession of Mr. Francis Wedgwood, at Barlaston, another in the possession of Major Marjoribanks, at Guisachan, while the public have the opportunity of examining one in Mr. Mayer's museum at Liverpool. To the faithfulness and beauty of the copies of the Portland vase, Sir Joshua Reynolds, dating from "Leicester Fields," 15th June, 1790, said, "I have compared the copy of the Portland vase by Mr. Wedgwood with the original, and I can venture to declare it to be a correct and faithful imitation, both in regard to the general effect and the most minute details of the parts."—Melbourne.

[51810.]—**Cell.**—I must refer "Leo" to the "someone else," but would caution him to make sure that the said someone else's advice is sound. For my part I do not see how his requirements are to be met.—Sigma.

[51811.]—**Stains on Prints.**—The stains on your prints are probably caused by their being touched by fingers which have been dipped in the hypo. solution before they are placed in it to fix. Be careful also that when first put into the solution they are evenly immersed at once. Soft or distilled water should be used to make the fixing solution with, and remember never to lay the prints down on dirty boards or tables before or after fixing or toning.—Machina.

[51812.]—**Levelling.**—The column headed "Intermediate," as the name implies, is used for readings taken on uneven ground, or, whenever deemed necessary between the back and foresights.—G. Worland.

[51812.]—**Levelling.**—Intermediates are the staff readings taken off the main line, and by most surveyors, and also in Baker's "Surveying," no distinction is made between them and the foresights. The intermediate column is merely a matter of convenience, as by entering such sights in it, it keeps the main foresights separate, and the latter are, therefore, much more easily distinguished, and thus readily added up when checking the field book.—M. C.

[51812.]—**Levelling.**—A couple of pages of notes torn out of an old field-book will explain the use and advantage of the intermediate column better than pages of writing. All bench marks, and anything not on the line of chaining, and, in fact, everything except the backsight and fore-

Back Sight.	Intermediate.	Fore Sight.	Rise.	Fall.	Height above base.	Distance. Chains.	Total Distance.	Remarks.
9·90	..	..	..	..	46·68	..	..	
..	10·20	..	..	·30	46·38	66·	..	Path crosses.
..	13·70	..	..	3·50	42·88	66·35	..	Ditch crosses.
..	8·90	..	4·80	..	47·68	67·	..	
..	7·80	..	1·10	..	48·78	68·	..	
..	4·85	..	2·95	..	51·73	69·	..	
..	..	4·80	·05	..	51·78	70·	..	
4·77	4·85	..	..	·08	51·70	71·	..	Field-road.
..	4·80	..	.05	..	51·75	72·	..	
..	8·00	..	..	3·20	48·55	..	..	Rails by bridge. Burntwood-lane.
..	3·48	..	4·52	..	53·07	..	BM.	Top of post by bridge marked ¼.
..	..	4·48	..	1·00	52·07	..	..	
13·00	10·30	..	2·70	..	54·77	..	..	On bridge approach where rails begin.
..	..	0·08	10·22	..	64·99	72·83	..	
1·71	..	0·84	·87	..	65·86	..	..	Top of bridge: centre.
29·38			27·26		46·68			
10·20		10·20	8·08	8·08	19·18			
19·18 rise			19·18 rise		65·86			

sight, go into that column, the result being that in the "checking" work at the bottom of the page you have only four backsights to add together, and four foresights, instead of 15 of each, as would have been the case had the two-column method been used. The column headed "chains" is generally used to contain the distances of the successive sights from each other; but when chaining the main line straight ahead, I generally enter the distances from the starting point in that column, though, strictly speaking, they ought to stand under "total distance." The book came from Waterlow's, where either kind is to be had. I greatly prefer the three-column plan, though I have often used the other for check levels where no intermediate sights are taken except a bench mark now and then.—J. K. P.

[51813.]—**Calculating Electric Light Leads.**—I do not much care about working out sums, and the practical questions put are not much in my way. But I have an article in preparation which will deal with the subject.—Sigma.

[51813.]—**Calculating E. L. Leads**—The only rule I know for calculating the size of wire for a certain current is to allow half a square millimetre for each ampère. Calculate thus: diameter^2 × (3·14)/4 = $\frac{\text{number of ampéres.}}{2}$ The E.M.F. does not enter into the question. To take your first figures, dynamo A gives 125 ampères. Required to know the diameter of wires which will carry such a current, $d^2 \times (3{\cdot}14/4) = 125/2 = {\cdot}785$ $d^2 = 125/2 = d^2 = 125/(2 \times {\cdot}785)$ = say 80—i.e., $d^2 = 80 \therefore d$ = nearly 9 millimetres. You can easily make this calculation for the other two examples yourself, 2 and 3. If you have an external R. of 12 ohms, it is quite certain you will not get 125 A. with 60 V.: you will get five only. However, suppose you have 60 V. and 125 A.; then you could arrange 50 lamps having 24 ohms R, and requiring 2½ A. in parallel, or 125 lamps of 60 ohms and requiring one ampère; B. 125 V., and 60 ampères. Suppose you have lamps requiring 1 ampère and having 25 ohms R., then you must arrange 5 in series and 60 parallel rows—i.e., 300 lamps. I hope this will fully explain the principle. F. G. A.

[51817.]—**Hygiene.**—For the study of this important subject, the following books may be read with advantage: "Practical Hygiene," by Dr. Parker; "Dwelling Houses, their Sanitary Arrangements," by Dr. Corfield; "Dictionary of Hygiene," by Dr. W. Blythe; "Sanitary Laws," by Lumley; "Factories and Workshops, their Sanitary Arrangements," B. H. Thwaite, C.E., see *Health* (weekly) edited by Dr. A. Wilson. The *Sanitary Record* and the *Building News* might be looked up with advantage.—Hygeinus.

[51818.]—**Battery for Coil.**—De la Rue's chloride of silver cell would probably suit. Its electromotive force is only about half that of the bichromate; but two cells could be used, and the resistance made sufficiently low by making the plates large enough.—J. Brown, Belfast.

[51826.]—**Vacuum Brakes on L. and N.W. Railway.**—Several of the main-line trains are now fitted throughout with the vacuum brake. Several engines of the following classes are fitted with the apparatus for working it:—Mr. Webb's "Precedents" and "Precursors," Mr. Ramsbottom's 7ft. 6in. singles and 6ft 6in. coupled expresses, and McConnel's "Large Bloomers." All Mr. Webb's compounds are fitted except "Experiment." All local trains are fitted with the chain brake, also the main line trains not yet fitted with the vacuum.—J. E. Spencer, Birmingham.

[51828.]—**Microscopic.**—There are some cats which have parasites instead of fleas; but I know not if the "caterpillars," described by P. Ward are their larva, as I have only the perfect creatures.—John Alex. Ollard, F.R.M.S., Enfield.

[51828.]—**Microscopical.**—If our young friend had pillboxed a lot of silkworms' eggs, I wonder if he would have expected to find, on opening the box, a lot of newborn moths? But, of course, in the case of such an intimate and everyday acquaintance as a flea, the existence of a larval condition is proclaimed to be a curious fact! If this incipient microscopist will place the next flea he finds on the stage of his instrument, he will perhaps be able to count that it has 9 segments in its abdomen, which, added to the head, and 3 in the thorax, make a total of 13; therefore it *is* a curious fact if his larvæ have only 9. As for the supposed spider's egg—well—?—Pulex.

[51828.]—**Microscopical.**—The eggs are, undoubtedly, those of the cat flea, and, inasmuch as fleas form no exception to the rule which obtains amongst the members of the insect world, when the eggs are hatched there emerge, not the perfect insects, but their larval forms. These, having passed through the usual stages of growth, in due course enter the pupa state, whence they afterwards emerge as perfect fleas. The eggs are of elongated form, and their pearly iridescence makes them pretty objects under the microscope when properly illuminated. When new laid, their slightly viscid surface causes them to adhere to the cat's fur, from which they are afterwards detached in large numbers by the animal's movements. If kept warm they will hatch in a few days, the larvæ being white, without eyes or legs, but having two small antennæ, numerous spiny hairs, and two small hooklets at the tail. There are commonly 13 segments, not nine, as stated by the querist. Eggs corked in a small glass test-tube, with a little loose wool from a blanket, will hatch freely if carried in the pocket for a few days, and with care and proper feeding the whole of the metamorphoses of the brood may be observed. When first hatched the larvæ will feed voraciously upon dried human blood, but it is not easy to rear them on this diet; blood which has been previously digested by the flea appears, however, to be their natural food, and on this they live and thrive. A supply of this aliment may be insured by keeping two or three fleas in the same tube, and allowing these to feed upon your arm *ad libitum*, at intervals.—R. T. Lewis.

[51830.]—**Photographer.**—"Amateur Tyro" should get two planed pieces of inch deal board, and lay the prints he wishes to wash one upon another carefully between several thicknesses of blotting paper, which place between the two boards; press in a screw press or by heavy weights; this will squeeze nearly all the water out of the points, then immerse them again in water, where they will soon separate from one another, and the process can be repeated several times. This is a most effective way of washing prints when water is scarce. Care should be taken not to underfix prints. Many stains arise from insufficient hypo.—Hayling Island.

[51830.]—**Photographer.**—I do not know of any way for removing "hypo." from negatives or prints but by constant washing. You should get up a cistern—a barrel would do first-class—which you could fill as often as necessary. You could have a tap at the bottom of your barrel cistern, and under this you can place your negatives, and allow a stream of water to flow gently on them, say, for a quarter of an hour or so. Then let them remain in clean water over night, and wash under stream again in the morning. Do not use any reagents to remove "hypo.," as they have also the tendency to weaken the image. This is the plan I have adopted under almost the same circumstances as those you mention.—W. Fawcette Gilcriest.

[51833.]—**Drawing-Room Screen.**—First make your frames, procure enough Drogheda linen (unbleached), and tack it tightly on, then coat with size; when dry cover this with what is known to paperhangers as lining paper (this sort shrinks as it dries); stick this as well as the pictures with very thick paste with a little glue and alum mixed in it, and you will make a good job of it, as I have done.—A., Liverpool.

[51835.]—**Contact Breaker.**—The rapidity of vibration might be reduced by connecting to the armature a piston working in a cylinder closed at one end, except a small hole for gradual escape of air as the piston rises or falls. By arranging a proper size of hole, the required speed can be given, provided, of course, the magnet is sufficiently powerful to work against this resistance. Or, if the speed is not to be much reduced, perhaps the addition of a flat plate to the armature would, by acting against the air, offer sufficient resistance to its motion.—J. Brown, Belfast.

[51837.]—**Compressed or Liquefied Gases.**—All the gases have now been liquefied. Many were reduced for the first time by Faraday. Andrews made most interesting and valuable researches on their boiling points, &c. Accounts of the work of both may be found in the *Proceedings* of the Royal Society. Oxygen and hydrogen were the last to yield to Cailletet in France and Pictet at Geneva only a few years ago. An account of the apparatus employed by the latter appeared in the English Mechanic at the time. I do not know of any book specially treating of the subject.—J. Brown, Belfast.

[51841.]—**To Mr. Wetherfield.**—The law existing at the Cape of Good Hope is the old Roman law. There is a special institution there which administers to estates and acts as executor. It is very popular in the colony, and bears a high character. A few years ago I was concerned for a large estate, a part of which had to be realised at the Cape, and this institution acted as executors of the deceased gentleman for the property there. The papers are now out of my hands, and I cannot give the exact name and address of it. It may be found in the "Cape Directory," at Street's, Cornhill.—J. D.

[51846.]—**Hyposulphite of Soda.**—It is far better to use a fresh solution for clearing negatives, and not the one you have already used for fixing prints. When the same hypo. solution is used too long, it gives off fumes of sulphur, which will cause any print or negative placed in it to ultimately fade.—Machina.

[51847.]—**Small Dynamo Working Induction Coil.**—A dynamo will work a coil very well if care be taken that the primary is not spoiled or insulation broken down by too much current. The late Mr. Spottiswoode found that if the brake be removed or screwed down, and an alternating current sent through the primary, a very peculiar, thick, and apparently continuous, discharge is obtained at the terminals.—J. Brown, Belfast.

[51849.]—**Commutator.**—On the axis of the armature, but insulated from it, secure two half-cylinders of metal, each connected to one end of the wires. Arrange two springs at opposite sides of the axis, so that one always presses on one of the half-cylinders. The position of the several parts is to be so adjusted that the spring passes from one metal to the other at the moment in which change of diversion of current takes place in the wire, then one of the springs will always be + because it is connected to that end of the wire which the magnetic actions render the positive end.—Sigma.

[51852.]—**Gazogenes.**—In reply to "Beta," the escape of gas is occasioned by the worn out condition of the indiarubber washer, which is fixed in a groove between the movable head and the collar. I have repaired mine by simply taking out the old ring and cutting out an indiarubber ring about a ¼in. thick, and putting in the place of the old one; but I would mention that when screwing on the head it is as well to use a little grease, as it is the friction caused by tightly screwing that destroyed the old washer.—No. 23.

·[51853.]—**Electric Lighting.**—The number of lamps must be equal in each of several series so as to make the resistance of each series equal. If this were not so (say if one series had three lamps, and another five), the current would rush through the three, and probably destroy them, while the other row would be only partially illuminated. The number in series, and also the number of series, has to be adjusted to the E.M.F. and internal resistance of the dynamo.—Sigma.

[51853.]—**Electric Lighting.**—"Veber" seems to have missed the point. Incandescent lamps must be arranged according to the current they require, and according to the machine feeding them. Thus, suppose I have a dynamo giving ampères at 40 volts; my lamps require 1 ampère each and their resistance is 40 ohms. Then I arrange all my lamps (60) parallel; but, suppose my machine gives 400 volts and only 6 ampères, then I arrange 10 in series and 6 parallel rows—i.e., 60 lamps. Perhaps you would like to read the latter part of my reply to question, No. 51813.—F. G. A.

[51854.]—**Legal.**—After signing such a covenant as you mention, you cannot, nor dare you, engage in or carry on any such business, either wholesale or retail. The covenant might even go farther than you imagine, as this clause of it is a very binding one.—W. Fawcette Gilcriest.

[51856.]—**Ozone Papers.**—I think the following (given in Cooley's "Encyclopædia") would answer your purpose better than ozone papers and with less trouble:—"Linden has suggested an easy method for producing ozone for hygienic purposes. Make a mixture of manganese peroxide, potassium permanganate, and oxalic acid. Two spoonfuls of this powder, if placed on a dish and moistened gradually with water, will generate sufficient ozone for an ordinary sized room. More water should be added when the evolution ceases. The powder may be kept in a bottle ready for use." The quantities are not given, so I suppose it does not matter what proportions are used.—R. A. R. Bennett.

[51857.]—**Mushroom Bed.**—These may be made if you have a cellar or outhouse where the temperature will not fall below 45° nor rise higher than 70° Fahrenheit (light not necessary). Make an upright boarding 30in. high from floor, and about 3ft. wide from wall. Take a quantity of fresh horse manure about 4in. deep, beat hard with a mallet, at intervals put in more and continue to beat firm till you have it about 18in deep. Now let it heat, and when the heat is on the decline and about the warmth of new milk (test this by putting in a few hard wood sticks), break your spawn (which you may get in bricks of any seedsman) into pieces about the size of a hen's egg, and put about 2in. below the surface and about a foot apart all over the bed, beat hard down, if good the spawn will soon spread in the form of filmy threads, then put on about 3in. of fine soil, again beat firm, and if the bed seems dry give a very little water. You must now wait some six weeks for your success. If it is a light cellar spread a little straw loosely over the bed. If not successful try again, as mushrooms are very eccentric in their growth. The above is a plan adopted in many gentlemen's establishments.—D.W.W.

[51862.]—**Radiant Heat into Light.**—If radiant heat be concentrated by a lens or concave mirror on a suitable incombustible substance, the latter may be raised to incandescence, thus emitting light. Radiant heat might raise steam to drive an engine to drive a dynamo to produce the electric light; or we might put it like the children's rhyme: This is the radiant heat of the sun, that raised the water that made the rain, that fell in the stream, that drove the mill, that turned the grindstone, that gave a spark that emitted the light that "P." wanted.—J. Brown, Belfast.

[51863.]—**Arranging Brass Band Music.**—The following arrangement will no doubt be found suitable to the querist:—1 soprano, 8 cornets, 2 altos, 3 valve trombones, two in B flat and the other in G; 4 E flat tenors, 1 B flat baritone, 2 euphoniums, 1 bombardon, 1 bass drum, and also 1 side drum, making in all 24 instruments for the same number of performers. The querist can, of course, make any alteration to this that he thinks more suitable to his requirements.—G. Fryer.

[51864.]—**Indicator Diagram.**—This is a similar case to one I had to examine last week. This engine had a 5ft. stroke, 70 rev., and 17in. diameter of cylinder. It was the high-pressure cylinder of a compound engine of 50 nominal horse power, made by a firm of high repute. On examining the main valve, I found the steam ports to be 7¼ × 1⅞in., this gives an area of 13¼ sq. in., but in centre of port there was a block (for valve spindle to pass through) 3½ × 1⅞; and this, subtracted, leaves scarcely 7¼ sq. in. actual area, or area of steam-port equals $\frac{1}{32}$ that of cylinder, when they should be at least as 1 : 12. The above clearly proves that whilst engine-makers pay more attention to the proportioning of steamways, so sure must wire-drawing continue. In your case, you should have sufficient lap and lead on main valve for it to cut off at ¾ the stroke; then place back slide-valves eccentric opposite the crank, and attend to the exhaust, which is now too late, both in the opening and closing. Indeed, the exhaust does not open wide enough for the free exhaustion of the steam. Having seen to the above, you will have done all that you can do in this direction.—Engineer, Dewsbury.

[51869.]—**Ozone.**—The following is from Bloxam's "Chemistry" (page 56):—The water the bottle is found to contain, besides the phosphorus and phosphoric acid formed by the slow oxidation of the phosphorus, some hydric peroxide, whence it has been sur [illegible] the formation of ozone is due to the decomposition of a molecule of oxygen into electro-negative oxygen, which combines with another molecule of oxygen to form ozone, and electro-positive oxygen which combines with a molecule of hydrogen to form hydric peroxide thus—

$$O_2 + \overset{-}{O}\overset{+}{O} + H_2O = H_2O\overset{+}{O} + O_2\overset{-}{O}$$

This view is supported by the circumstance that hydric peroxide is produced in every case when ozone is formed in the presence of water.—R. A. R. Bennett.

[51871.]—**Keel for Model.**—The method I have adopted is to make a mould by tacking pieces of wood on a board of suitable length, breadth, and thickness for the proposed keel, of course allowing for planing it all over when cast, with an iron-soled plane, having the iron set at an acute angle. (Memo: Stir your lead with a tallow candle, and skim with a bit of deal wood before pouring, to get a sound casting). Fasten by means of screws from the inside, drilling holes (very loose and screws well greased) in the lead.—A., Liverpool.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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51192.	Engines, 489.
51196.	L.N.W. Locos, 489.
51206.	Pine Wool, 489.
51209.	Lawn Tennis Court, 489.
51210.	Clock to Show Positions of Sun, Moon, &c., 489.
51224.	Telephone, 490.
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51434.	Small Thresher, p. 585.
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51441.	Ariosto, 586.
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51472.	N.E. Locos., 586.
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51481.	Optics, 587.
51485.	Engine Query, 587.
51489.	New Zealand, 587.
51490.	Noise in Lavatory Waste, 587.

Sleeping with the Head Northwards.—M. G. de Rocquigny writes as follows to M. l'Abbé Moigno, editor of *Les Mondes* on this subject:—"M. C. Vignier wrote as follows in the *Revue Philosophique* for 1882, No. 7, July, p. 31.: 'Is there, then, an agency capable of exercising a continuous action on the apparata of the nerves (*canaux*), varying with the position of the head? To my mind this agency exists, and is none other than terrestrial magnetism. That an all-pervading force should be without any action on our organism when we see it influenced by the least variation of light and heat is surprising enough already. But it is beyond dispute that galvanic currents not only exercise a powerful effect on our nervous system, but that electro-magnets themselves produce well marked effects in certain nervous affections. The experiments undertaken at Salpetrière by M. Charcot leave no room for doubt on this point; and there must be some foundation for the practice adopted by the Swedish peasants, who cause themselves to be buried for several hours so as to lie north and south in order to cure neuralgia.' To this the author adds the note:—'I have this fact from M. Nordstrom, Swedish Consul at Alger. It is, moreover, sufficiently proved by physiological experiments that a very close relation exists between the nervous system and electricity, of which magnetism is but one form. In another note the author quotes the following experiment, carried out by M. Ziégler, of which, M. Vogt was a witness:—'M. Ziégler takes a lens of soft iron, he exposes it in a place where it will receive the lines of terrestrial magnetism and redirect them on to the organ to be studied. By thus projecting the magnetic lines concentrated in this manner on the heart of a rabbit, the rhythm of the heart is changed; if the lines are concentrated on the intestine, violent peristaltic movements (*péristaltiques*) are caused (*Journal Officiel*, May 18, 1881). The preceding facts will, perhaps, appear to you, Monsieur l'Abbé, to add some degree of probability to the theory put forward by *The Electrician* of London.'"

QUERIES.

[51872.]—**Bees.**—Will some one answer the following queries, viz.: (1) Why not transfer bees after September or before April? (2) What is the best time for introducing Ligurian or other queens to an alien stock? Would not this be a good time to introduce them to drummed or condemned bees? It would be so easy to find the queen. (3) Could I get them in Ireland and at what price? (4) What do bees do with the honey they consume when smoked? Do they put it back again? (5) Suppose a hive 15lb. weight, gets 15lb. of syrup, say, in a month, will they store it up just as they get it or convert it into honey first? (6) What is the object of putting vinegar in the syrup for bees? Is it to destroy the grain of the sugar? If so, would not cream of tartar be better? (7) Some of the foundation in my bars sagged so much that one side there was scarcely room for any cells, and at other side they were made nearly twice the ordinary extent. Whether the eggs laid in extra sized cells will bring out bees the same size as the small ones? (8) What is the best wood for making bars for a frame hive? (9) Would some of the readers of "E.M." who have been out in Manitoba, kindly say whether it is a good place for bees, whether it is hard to get them there, and what kind thrive best?—F.

[51873.]—**Fir and Deal in Specifications.**—Under head of Carpenter and Joiner I read "all fir to be best crown Memel," and "the deals or battens to be Christiania, Archangel, or Petersburg." What I want to ask is: Why should all fir be best crown Memel, and why should all deals and battens be Christiania, Archangel, or Petersburg? What is the difference between Memel, and Christiania, Archangel, or Petersburg?—J. Corson.

[51874.]—**Stone in Specification.**—What does a "tooled bed stone" for a column to rest on mean? And why are bedstones under girders described as "tooled stone templates under ends of girders with boasted beds."—J. Corson.

[51875.]—**Starch and Gluten in Flour and Wheat.**—I should be exceedingly obliged if any chemist could give a simple means of getting the approximate quantity of starch and gluten in flour or wheat.—W. S.

[51876.]—**Calls for Birds.**—Will some of your readers kindly explain how to make a whistle or call for plover, partridge, &c.—F.

[51877.]—**Telephone for 140 Miles.**—To Mr. Lancaster or Mr. Tolman.—Will you kindly give me a few hints as to the most suitable proportions for an induction coil for a telephone trensmitter to work on a line of 140 miles using a Bell receiver? What I wish particulary to know is: (1) Length and diameter of core, size and number of layers of primary wire. (2) Size of secondary wire, also quantity of the same either by weight or number of layers. (3) Is there any rule by which I may know how many Fuller's mercury bichromate cells I require to operate the call bells on a line of, say, 10 to 20 miles, using the line current to ring bells, line wire No. 8, galvanised iron. Will you also give your opinion on the following plan for operating the call bell on line of 140 miles. I propose to send current from the line through a vertical galvanometer. On the spindle carrying the astatic needles, is a piece of thin sheet platinum, which, when the needles are deflected, will press upon another piece of platinum and put the bell coil in circuit with the local battery. Will this do? Or, would a relay be better? Please to give resistance of coils for whichever you think best. Replies to the above as explicit as possible, will much oblige—New Zealand Telephone.

[51878.]—**Electrical Attachment to Organ Keyboard.**—I have an idea of fitting up an electrical keyboard for organ as follows:—An electro magnet to be placed under each pallet with armature fixed to pallet wires, to be conveyed thence to keyboard, to be placed at a distance of, say, 30ft. from organ. The effect would be, that upon depression of each key in playing, a circuit would be completed, which, through the magnet and armature, would attract each pallet and so emit sound in the usual way. Would any of our correspondents kindly offer me some advice, together with information as to form of battery best suited to the purpose, with sizes of wires and magnets, or please suggest any better method, as this is simply my own idea? Any hints will be thankfully received by—New Subscriber.

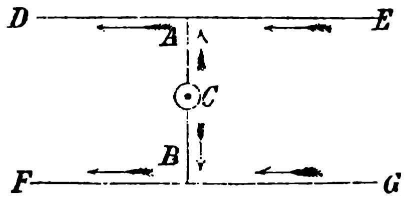
[51879.]—**Locomotives.**—Can any of the readers of the "E. M." kindly inform me whether the "dimensions of locomotives" given on pages 506—517 of Molesworth's "Pocket Book," are taken from engines now running?—and if so, to what lines do they belong?—St. Aubyns.

[51880.]—**Pressure on Screw Propeller.**—Will some of ours kindly give the rule for finding the pressure per square inch on a screw propeller? Suppose the engines indicated 300 horse-power, and we deduct 25 per cent. for friction, &c., the propeller 12ft. diameter, with four blades, each blade 10 square feet of surface, or area. What will be the pressure per square inch on the four blades?—Screw Shaft.

[51881.]—**Gas-Making Apparatus.**—Can any of your readers inform me about what would be the cost of, and fixing a plant for a small works in the country, consuming, say, from four to five hundred thousand cubic feet per annum? Also the comparative cost of gas made from coal at 8s. a ton, and from shale oil? How much fuel would be required to produce 1,000ft. of gas? Any information relating to the above will be thankfully received.—J. P. Seddon.

[51882.]—**Engine Query.**—Can any correspondent tell me the advantage of inside and outside cylinders for locomotives, as there appears to be some advantage in both?—Ingenieur.

[51883.]—**Electro-Dynamics.**—Can "Sigma," or any other of our electrical friends, explain the following, as I am evidently at fault somewhere. A B is a horizontal wire capable of turning on a vertical axis C, the electric current ascending by it and moving outwards as shown; the lines, D E, and F G, representing the magnetic currents of the earth circulating from east and west. According to Ganot's "Physics," the wire A B ought to rotate from east to west. Now I can't understand how this can take place, for, by Ampère's law of angular currents, the half A of the wire A B would move in the direction E, and the other portion B towards



G, so that two equal and contrary forces would be acting on the wire A B, and therefore no movement could take place. An explanation of the above would greatly oblige an—Anglo-Australian.

[51884.]—**Gravel from River.**—To Mr. F. Wetherfield, or "Lex."—On one side of a tidal river the land is in the hands of a landed proprietor, who holds title to a "several fishery" on the river. On other side land is in possession of an other person, who claims as far as his land runs, to have a right to half the river for the purpose of fishing, and also to lift gravel, sand, and stones from the bed of same. The landed proprietor denies this right to the gravel, &c. Has he the law on his side? If it be decided that he is only entitled to claim half the river, where is the dividing line to be drawn? Midway between the banks, as filled by the tide, or middle of the stream when the tide is out? It is only then that the gravel, &c., is laid bare and can be secured. There is a public right of way into bed of river. Can the man who does not hold the fishery send his carts by this way into the river, cross over to his own side or half of river, and take away sand and gravel from there, without rendering himself liable for trespass? It was stated in a former reply, when somehow the query was wrongly printed—"general" being printed instead of "several"—that the sand, &c., all round coast belonged to the Queen.—Justitia.

[51885.]—**Wages.** — To Mr. F. Wetherfield or "Lex."—A ploughman is engaged at so much per week, with free house and ¼ acre of potato ground which he is to seed and manure for himself, as part of his wages. By subsequent agreement, in writing but not stamped, he engaged to give three months' notice before giving up his service and in May he gives notice that he will leave in August. This he does and enters the service of another, giving up possession of the house, but holding the land, as the crop is not ready for lifting. As he received the ground as part of his wages, when he leaves his first service and enters another, can he still claim the free use of the ground till it is convenient to him to remove his crop? If not, what remedy has his first master, supposing he does not wish to have to buy or give compensation for the crop, but only to get compensation for use of his ground by a man who being no longer in his employ, ought not to be entitled to get wages from him while he is working for another? Man entered on service in January. What rent or portion of rent is master entitled to deduct from balance of wages still in his hands? Supposing him to have left immediately after putting crop into ground in April, would he not be entitled to pay the whole con acre rent like any other man?—Diago.

[51886.]—**Wimshurst Influence Machine.**—I am about to build a Wimshurst machine, with 16in. plates and should feel obliged if any reader could give me the following information. (1) How many sectors should I need, what length and width, and how can I fasten them to the glass? (2) How can I fasten the plates to the wooden bosses? (3) Would a metal spindle answer instead of wood or ebonite? (4) What varnish must I use for the plates? (5) Would the rod that carries the wire brushes do if screwed on to the framework over the ends of spindle? (6) What length should the collecting combs be, and how many points on each, and how far from the sectors? A drawing of the sectors would oblige.—W. J. P.

[51887.]—**Pyrogallol.**—On page 417, Vol. XXXII., there is given a simple method of preparing the above for dry-plate development. I have tried and failed. I proceeded thus. I obtained a tin saucer and put in a little sand; I then took a 2oz. gallipot and put in the glycerine, then the gallic acid, and stirred together, put them into the sand and then stood them all on a small paraffin stove, turned up the burner, and when the bubbles began to rise turned it down so as to just keep the bubbles rising; kept it so for about half an hour (I had no centigrade thermometer); when cold I tried a plate but got no result: I then tried another with double the amount of ammo., then I got a very faint image. I then tried with double the quantity of pyro., but with no better result. I bought the gallic acid at a photographic chemist's at 6d. the ounce, and the glycerine at an oilshop. I should be glad if some one would tell me where I was wrong and put me on the right road? I can take very good negatives with pyrogallic acid bought at a chemist's, with the same plates that I tried the above with.—Amateur Photo.

[51888.]—**Dynamo.**—I have a dynamo with Siemens H armature, and it will not work; will you oblige by pointing out the defects? The cores of the electromagnets are 7in. long, ½in. thick, 3in. broad, each wrapped with about 96 yards of No 18 wire. The armature is 2½in. diameter, 7in. long, wrapped with about 80ft. of wire same size as electro-magnets.—A. J. B.

[51889.]—**Hammering Cast Engine Rings.**—Can cast metal rings of a steam engine be hammered out to size of cylinder after they have been working till they are not steam tight?—if so, how is it done? I would also like to know if there is a way of hardening pincers for pinching waggons. I have a good many pincers to sharp, and they all come in soft. I heat them till they are a bright red heat, and then give them all the water; and they always seem to be soft.—D. W.

[51890.]—**Tubular Pneumatic Action.**—Would some reader well versed in organ building tell me just what is understood in England by "Tubular Pneumatic Action" and how it differs from the "Pneumatic Action"? If there are several varieties of pneumatic actions, a statement of their distinguishing features would be acceptable to others beside—U. S. A.

[51891.]—**Brazing.**—Will "Jack of All Trades," or any of ours tell me how to go to work to braze a hollow bicycle back to the solid neck. Could I do it at an ordinary fireplace?—or must I have a forge? Also, what appliances I should require, as I have never done any brazing before? Also is there any good practical work published on brazing and soldering?—C. B.

[51892.] — **Substitute for Beeswax.** — In my manufacture of a hair dressing, I use bleached or white beeswax, which suits my purpose admirably; but its price makes it a serious objection. Could I be enlightened as to some other wax or similar compound at a much cheaper rate? I may mention that I have tried spermaceti wax, and I found same, in common with Japan wax, to be unsuitable in their texture; they are very brittle, and consequently do not produce the same smooth pasty and beautiful elastic substance that wax does.—J. R. Wyllie.

[51893.]—**Simple Planing Machine.**—Can any reader oblige me with a description of simple planer to use in lathe, or otherwise, to plane fancy woods up to 3in.?—and please state if the same tool could be converted into a small moulding machine to strike mouldings up to 1in.?—Lumber.

[51894.]—**Model Marine Compound Engine.**—Will some of your correspondents kindly inform me if it is possible for the above engine, with crank at right angles, to work without an intermediate receiver between the cylinders?—Navire a Vapeur.

[51895.]—**Old Files.**—What treatment can I give old files, to make them grind easily on the stone, so as to make chisels and turning tools of them?—Semper Fidelis.

[51896.]—**Pise Blocks.**—Can anyone say how these were made, and describe their manufacture? I mean those made in England 30 or 40 years ago, of earth for the walls of houses.—Semper Fidelis.

[51897.]—**Battery for Continuous Work.**—Will Mr. Lancaster, or some other practical electrician, favour me with their opinion on the following points:—I have a shocking coil which I wish to keep in continuous action for 17 or 18 hours daily, and I require a suitable battery. The coil is 6in., diameter of core ½in., primary two layers 16 silk, secondary 12 layers 32 silk. With one Bunsen cell and the regulating tube half drawn, I get a shock I can scarcely bear, and with the tube fully drawn the shock is very powerful. I have had it on an ordinary telegraph battery, a six cell trough Daniel, with a surface of about 108 square inches of zinc exposed, and by coupling up for quantity I get a moderate shock. I think a Daniell could be adapted, and my idea is to make a box divided by porous divisions into five compartments capable of containing a plate 10in. square in each division, and by having two zinc plates alternating with three copper plates, the internal resistance would be low, and the zinc surface exposed would be about 400 square inches. As to constancy, I have three round Daniell cells now working the coil, and which have worked it without intermission for near upon 100 hours, and still no signs of flagging. If my idea is a feasible one, where can I get porous plates about 12in. square, or can anyone suggest a substitute, or give me instructions how to make porous plates? Also, can anyone suggest a good substitute for marine glue for lining the box? Is there any other description of battery that will work the coil, say for a month without recharging?—One in a Fix.

[51898.]—**N.B.R. Locos.**—Can any reader kindly give me the following dimensions of the single-driver locomotives on the North British railway, named Berwick and Glasgow, Nos. 474 and 475, diameter of cylinders and length of stroke, height of driving and leading wheels, height of chimney, and from top of chimney to rail?—Theodore Godfred Gassler.

[51899.]—**Medical Coil.**—I am in want of a compact electrical induction apparatus to give a power just a little too much for anybody to bear. I thought of having two small coils fitted into the brass handles; but a manufacturer says they would not act except wood be put between the coil and the brass tube. Will Mr. Lancaster, "Sigma," or any of our electrical correspondents kindly state if this is so? How many small (about 3in. long by 1in. diameter, or probably a little larger) would be required?—Thor.

[51900.]—**Thermo - Electricity.** — Can any of "ours" give any information about thermo-piles, for coils alluded to above? I have an idea that a thermopile to be worked by a methylated spirit gas blowpipe—the physician would have the gas with him—would be more compact, cheaper, and certainly not so malodorous or filthy as a hydro-battery. If some one will give a diagram of such a one (with blowpipe) that would work in the open air, I should be much obliged, but if thermopile not more compact than acid battery (with platinum plates) please give design for the latter instead.—Thor.

[51901.]—**Chief Rent.**—A. lets 360 square yards of land to B. on chief; B. in the course of time transfers it to C. with the building that is upon it; C. wishing to have a passage up the side of the building arranges with A. for one of 6ft. wide, which amounts to 60 yards, but has no lease or transfer as conveyance respecting it. Years roll on, and A. sells his chief of 360 yards, but the 60 yards not being in the chief, it does not go with it, and two or three years after the chief is sold, A. demands his rent for the 60 yards, but C. has parted with his building to D., and D. having no use for the passage does not like to pay for it. The query is, can A. compel D. to pay for the 60 yards which is of no use to him?—Alpha.

[51902.]—**Fine Spiral Springs.**—Can any reader tell me how fine spiral springs of brass or steel wire are made?—H. E. B.

[51903.]—**Colouring Iron Hoops.**—Will any reader kindly inform me of the best and simplest way of colouring or staining blue, new iron hoops on casks and tubs which have to be polished?—something similar to the blue stain on edged tools, that will not rub or chip off.—Oval.

[51904.]—**Lead Keel for Model Boat.**—Will any of your scientific readers give their opinions as to the best arrangement of the lead on keel? Some authorities say "let the weight behind be much more than at the bows"; but this makes the boat run off the wind. Others say "let the greatest weight be just abaft the centre, as the boat will thereby be more lively and ride better, as the weight in the centre acts as a pivot."—Wave.

[51905.]—**Tool Cabinet.**—Some short time ago I purchased a chest of tools of one of the firms that advertise in your paper with which I am thorougly satisfied, with the exception that, like all other tool chests that I have seen, the tools being of such diverse shapes do not permit of any arrangment in the chest or packing, but are all pell mell; so I have had a cabinet made to fix against the wall, 4in. inside from back to front, and I shall be glad if any of your readers will suggest some orderly way of arranging them, as I find this state of confusion is a general complaint, and one which many would be glad to know how to rectify.—Wave.

[51906.]—**Diaphragms.** — To Mr. Lancaster.—I have been making a set of diaphragms out of sheet brass, but cannot blacken them. I want a stain for them. I have tried strong ferri perchlor., but it does not make them dark enough.—J. C. B.

[51907.]—**Turbine.**—To Mr. Lancaster. — What power and light can I obtain from an inch pipe running constantly at 50lb., by means of a small turbine and dynamo, and what would the turbine cost?—B. D.

[51908.] — **Shakespeare on the Stars.** — To "F.R.A.S."—Pray what star does Shakespeare refer to in the first line of Act I. Sc. II., of "Winter's Tale": "Nine changes of the watery star have been the shepherd's note." Again, in the same play, Act V. Sc. I., Florizel is made to say—"The stars, I see, will kiss the valley first." What is meant by the stars kissing the valley? In "Measure for Measure," Act IV. Sc. II., the Duke says, "Look, the unfolding star calls up the shepherd." What is meant by the unfolding star?—Kelby.

[51909.]—**Texas.**—In a few weeks I am going out to Texas, farming and stock-raising. I should be very much obliged if any of the kind readers of "ours" would inform a strong healthy man with a small capital (and not afraid of work) how he had best proceed in procuring land, &c., and the best part of Texas to go to? Also, could they recommend me any good practical books on the above subjects.—W. F. J.

[51910.]—**Canadian Locomotives.** — Can any correspondent kindly give some information, with sketches of locomotives in use on the Canadian, Pacific, and other lines? Are there different classes for passenger, express, and goods traffic, and do they make as good time as English engines?—Russell.

[51911.]—**Employment in Canada.**—Can Mr. Tuttle, or other foreign correspondent, say what chance there is for draughtsmen and young inexperienced engineers getting employment on railroad or similar work in the States or Canada? Any information as to this, and also the mode of construction adopted, will greatly oblige.—Russell.

[51912.]—**To Violinists who are Mathematicians.**—Is there any mathematical principle which may be apprehended and applied in the tuning of the violin, so that it may, under such application, be infallibly pronounced to be in tune, irrespectively of or concurrently with (as that itself may or may not be accurate) what is termed the judgment of the ear? If so, what is that principle?—Student.

[51913.]—**Hydraulic Rams.** — Can any of your readers familiar with hydraulic rams kindly give me an answer to the following question?—It is stated over and over again by Mr. Davies and other writers that in some rams the fall of the pulse or outer valve after each stroke is secured by its weight alone, which counterbalances the pressure of the trunk water when at rest. If this is so, it is easy to calculate the required weight for any given case—e.g., a 3in. valve worked by a 10ft. fall would have to weigh a little over 30lb. This would be a small ram for ordinary sizes. The weight (increasing as the square of the diameter) would be three or four times as great. My question, then, is this Do any of your readers happen to know of rams actually in existence having outer valves weighing 30lb., or anything like that weight, and if so, where should I have a chance of seeing one?—W. A. S.

[51914.]—**Feed-Pump.**—Can any reader give me design of feed-pump, with dimensions and amount of water to be delivered at each stroke, to supply boiler of model portable engine, pump to be bolted on side of boiler direct under crankshaft, worked from an eccentric on same; size of engine—cylinder, 1¼in. bore, 2in. stroke, steam-pressure 15lb. on sq. in. Also, do you think the above-named cylinder over-large for a boiler of the following dimensions?—Length of boiler shell 9in., diam. 5in., with firebox 8in. high; 5 by 5½ sq. internal firebox, giving water space all round; 20 tubes ⅜ diam. What would be the best fuel to burn for this size of boiler?—Stultis.

[51915.]—**Batteries in M.R. Signal Boxes.**—Will any of our readers inform me what kind of battery the Midland Railway Co. use for their signal boxes, and if they use earth return or not?—A Lover of Ours.

[51916.]—**Gasometer.**—Can any of our readers give a description of how the different ways of getting the oxygen gas out of the tanks is done in the theatre for the limelight? By some it is pumped out, and I have seen the gasman get it out without pumping at all. There are two tanks and a retort.—G. A. S.

[51917.]—**Battery for Bell.**—In some shop-windows I have seen an electric bell and battery combined. The cell is a zinc one with a carbon rod in the middle, and packed around with some kind of salts. Can any of our readers tell me of what the cell is composed, and how charged?—G. A. S.

[51918.]—**Eyepiece.**—Will any reader tell me how to construct an erecting eyepiece, cheap, and with as large field as possible? The o.g. is 2¾ Wray's, 42in. focus. want a power of 42 dia. Will three 1in. plano-con-give me the power, or must there be a double convex between the field and middle one? If so, of what focus must the double convex be, and what distance must they be placed apart? Is the polar star a good test for a 2¼, and if it shows the companion of polar star, would it be possible to see division in the Ring of Saturn, or any of its satellites? I have often split the polar star, and I fancy I have seen the division in Saturn's ring.—A. Best.

[51919.]—**Ampere Meter, &c.**—Will some kind reader give me the directions how to make a volt and ampere meter? Hints, &c., will be thankfully received by—Volt.

[51920.]—**Dross.**—I have a large quantity of dross from type metal by me. Will some reader give me directions how to recover the metal from it? It can be done, for up till lately I have sold it to a large London metal refiner, who would not buy it if he did not get something out of it.—Volt.

[51921.]—**Model Steamer.**—I am anxious to build a model steamboat on the lines of the Guion steamers, length to be about 4ft. 6in., and shall feel very thankful if any reader will kindly give me a small sketch of the framework ready for planking. The engine for her I have already. It is launch pattern, 1¼ by 2in. cylinder, inverted, and ought to drive her at a good pace. What size screw propeller and boiler should I require? Also, where could I get scale drawings of launches and large steamboats, ironclads, &c.? Any information will be sincerely appreciated.—Paulatim.

[51922.]—**Model Steam Pump.**—I have a model of a Universal steam pump: bore of steam cylinder 1¼in., stroke 3½in., and wish to make it into a model steam fire-engine, after the pattern of those manufactured by Merryweather, of London; but am at a loss as to size of boiler—which must be a vertical one. The boiler I propose to make of copper, with tubes. The engines made by Merryweather have a "Field" boiler, with tubes projecting into the firebox; but where to get tubes of, say, ⅜in. or ½in. stopped at one end, I do not know, so must endeavour to make them, and shall be glad if any fellow-reader will give me a wrinkle or two.—Volunteer Fireman.

[51923.]—**Damp Cellar Vaults.**—I have some arched cellar vaults, the brickwork of which lets in the damp from the surrounding clay. What is the best way of rendering them dry, if any, and what would be the cost—which must be low?—Inquirer.

[51924.]—**Staining Golf Balls.**—Can any correspondent give directions for staining golf balls a bright red? This colour is much more easily distinguished than white upon grass, and especially upon shingle. I have tried red sealing-wax dissolved in spirit, but this soon chips off.—Hayling Island.

[51925.]—**Ink.**—I should be glad if any subscriber could give a reliable recipe for stencil ink, black, red, and green, and if possible the latter not poisonous?—No. 23.

[51926.]—**N.R. Locos.**—To "Meteor."—Wanted list of goods engines stationed at Wellingborough, London, Bedford, Leicester, Nottingham, Skipton, Carlisle, and Manchester.—J. E. Spencer.

[51927.]—**Boilers.**—To "Boswell." In your reply to "The North," of August 10th, is just what I am wanting. I wish to be my own boiler inspector, but do not know how to get the bursting or working pressure of boilers. I can do plain figures up to decimals, but I do not understand the [illegible] in that the tensile strength of all metals or boiler plates? Will you be as kind as to give me the bursting pressure of our boiler? also working pressure? Diameter of boiler inside, 6ft. 11in., length 24ft. 1in., diameter of fire-tubes 2ft. 10½in., four tubes in each flue, 9in. at one end and 4½in. at the other, plates ½in. thick, ends ⅝in., fire-tubes ⅝in. Also, what will be the horse-power of same? Also is the book that you mention to "The North," in plain figures, as it will be no good to me if not?—Young Engineman.

[51928.]—**Spectroscope.**—What are the indications in this instrument that foretell rain? I have got a small pocket or "rain band" spectroscope, and would like to know what experiments I may produce with it, and how to diagnose the weather.—A Spectre.

[51929.]—**Microscope.**—In the last Vol. of "E. M.," there is an article on the curious hirsute covering of the paramecium when a solution of quinine is added to the water in which the creature swims. Has any of our microscopists verified this experiment? The so called hairy covering appears strangely like a fungoid growth, or a sudden crystallisation of the quinine. As the living creature swims past other animalcula, I cannot see the least indication of those long hairs or cilia which cover the dead specimen.—E. B. Kennedy.

[51930.]—**Teazles.**—Are teazles used nowadays in the woollen industry, and where are they grown? Are they wild [illegible]? What is the cultivation? I want a few to see what they are like, as I read that in 1859 about 19 million heads were imported from France and sold at five shillings per thousand. It is the Dipsacus Fullonum, not the wild species, I mean. I think it might be cultivated on waste places in Ireland and elsewhere.—P. R.

[51931.]—**Lathe.**—Will some one kindly help me out of the following difficulty? I am about fitting up a 4in. lathe, and am in ignorance as to what height to make the standards. I am 5ft. 9in. high, and should be glad if some reader would give me his experience as to what height the surface of bed should be from ground, so that I may get the best command over the work. Also, which is the best plan to adopt with reference to fixing the driving wheel: keyed on a crankshaft, or made to run on a stud projecting from the standard? Any further hints as to the simplest way of fitting up, would be gladly received by—W. H.

[51932.]—**Parasites on Bees.**—I have just discovered that several of my hives are infested with a large brown parasite, which I believe to be Braula cœca. One hive in particular is so bad that nearly every bee is affected. This hive is rather weak. All the others, more or less affected, are very strong. Is it possible to get rid of the pest, and how?—[illegible]

[51933.]—**L. & N. W. Locos.**—Of whose design are [illegible], and in or about what year were the engines of the classes to which the following belong, respectively, rebuilt?—304, 531, 604, 148, 1005, 980, 958, and 1888.—J. E. Spencer.

[51934.]—**Legal.**—I should be glad to have the following question answered by Mr. Wetherfield:—S., a married woman, died in 1837, and left a legacy to her niece, M., but it was not to be paid till the death of her husband. He died in January, 1883. Is M., who is a married woman, entitled to the benefit of the Married Woman's Act that came into operation on the 1st of January, 1883?—W. T.

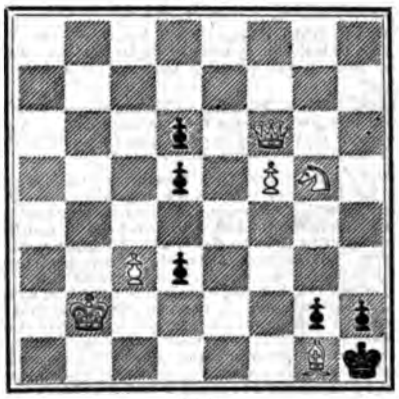
[51935.]—**The Law of Copyright.**—To Mr. Wetherfield and Others.—Can Mr. Wetherfield or any of your readers tell me what is the law as applied to the following case?—A. contributes an article to a magazine, and is paid for it by the proprietors. Other publications copy it, without so much as acknowledging the source. With whom does the right of action lie, if any action can be brought at all?—E. G.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLV.—"Who's Afraid?"

Black.



White. [6+6

White to play and mate in three moves.

Solution to 853.

White.	*Black.*
1. Q to Q Kt sq	1. Anything
2. Q, R, B, Kt, or P mates	

(Nine variations.)

NOTICES TO CORRESPONDENTS.

Correct Solutions to 853 by Mortimer, D. Mackay, C. Planck (neat and well constructed, but rather easy), Dicky Sam, R. A. Bennett, J. B. of Boxford (extra good), A. E. S., G. S. Follwell (the best two-mover: this puzzler about it—five or six likely first moves with mate in all the variations but one: very clever and enjoyable); to 852 by Dicky Sam.

G. S. Follwell.—We replied to your query last week.

J. B. of Boxford.—We wish there were ten times the number of solvers: but "though you bring a horse to water, you cannot make him drink." Please send solution always. Problem can still be done—thus, 1. B-K 8, 2. K-Q 4, 3. K-Q 5, 4. Kt mates.

Game received with thanks from H. B. Reynolds.

English Mechanic Tourney game between J. H. Blake (*White*) and J. Jowett (*Black*).

(Scotch Gambit.)

1. P-K 4, P-K 4 / 2. Kt-K B 3, Kt-Q B 3 / 3. P-Q 4, P takes P / 4. Kt takes P, B-B 4 / 5. B-K 3, Q-B 3 / 6. P-Q B 3, K Kt-K 2 / 7. Q-Q 2, Castles / 8. Kt-Kt 5, B takes B / 9. Q takes B, Q-K 4 / 10. Kt-Q 2, Kt-Kt 3 / 11. Kt-K B 3, Q-K 2 (*a*) / 12. Kt takes B P, R-Kt sq / 13. Kt-Q 5, Q-Q sq (*b*) / 14. B-K 2 (*c*), P-Q 3 / 15. Castles K R, P-Q Kt 4 (*d*) / 16. Q R-Q sq, R-K sq / 17. Kt-Q 4, Kt takes Kt / 18. Q takes Kt, P-Q R 3 (*e*) / 19. P-K B 4, Kt-K 2 (*f*) / 20. Kt takes Kt (ch), Q takes Kt / 21. Q takes Q P, B-Kt 2 / 22. P-K 5, P-K B 3 / 23. B-Kt 4, P takes P / 24. P takes P, Q takes Q (*g*) / 25. P takes Q, B-B 3 / 26. P-Q 7, K R-Q sq / 27. B-K 6 (ch), K-R sq / 28. R-K B 7, P-K R 3 (*h*) / 29. Q R-K B sq, K-R 2 (*i*) / 30. R-K 7, K-Kt 3 / 31. B-B 5 (ch), Resigns (*k*).

Notes.

(*a*) Why not Q-B 5?
(*b*) Nothing better: but sadly defensive.
(*c*) R-Q sq looks more forcible.
(*d*) Ditto P-K B 4.
(*e*) Weak again; B-K 3 or R-Kt 2 is far better.
(*f*) This loses Q P. It would probably have to go in any case, but B-Kt 2 seems stronger.
(*g*) All this, though it isolates the P, is playing White's game; but has he anything else?
(*h*) If R-Kt 2, R-B 8, ch, &c.
(*i*) B-K 5 might have prolonged the torture.
(*k*) For if 31. $\frac{}{\text{K-Kt 4 or R 4}}$ 32. $\frac{\text{R takes K Kt P}}{}$ and forces mate in a few more moves; and if 31. $\frac{}{\text{K-B 3}}$ 32. $\frac{\text{R-K 8 (ch)}}{\text{K moves}}$ 33. $\frac{\text{R takes B}}{}$ Altogether Black's play has not been brilliant.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

We receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 894, 897.
Bookbinding: Nos. 613, 627, 770.
Cements: Nos. 377, 729.
Coils, induction: Nos. 620, 640, 779, 797, 832, 885
Coils, medical: Nos. 844, 898.
Copying processes: Nos. 750, 753, 761, 762.
Electric bells: Nos. 545, 558, 797.
Electric machines: Nos. 368, 380, 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Electro-plating: No. 833.
Lacquers: Nos. 429, 475, 622, 866.
Magneto-electric machine: Nos. 376, 589, 783, 826.
Nickel-plating: No. 808, 811.
Silver-plating: Nos. 830, 868, 869, 870, 871, 874.
Telephones: Nos. 692, 695, 747, 781, 809, 828, 846, 853, 865, 894.
Varnishes: 321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 3. and unacknowledged elsewhere:—

A. J. Herbert.—C. J. Gaudibert.—T. J. Vanstone.—Dr. R. B. Warren.—T. Fletcher.—R. H. Blyth.—Mottershead and Co.—Parkinson and Frodsham.—J. J. Sparrow.—Cuttriss and Co.—J. Bell.—T. W. Bond.—G. Davies.—Mawson and Swan.—J. R. Rhodes.—Hunter and Sands.—Rev. T. Calliphronas.—Jabez Francis.—H. McLaren.—Imprimatur.—London Stone.—E. W. R.—Achromatic.—Condiment.—J. G.—W. H. Richmond. W. B. Wicken.—Gossan.—R. R. C.—H. A. Wassell.—J. C. L.—G. W. Bulmer.—F. C.—Lieut.-Col. Ross.—B. J. Hopkins.—W. H. M.—M. E.—J. E. H.—W.—Norwood.—Grapho.—Mufti.—H. W.—A Fellow of the Royal Astronomical Society.—E. R. Dale.—Gavin J. Burns.—W. S. Franks.—C. R. Marten.—Subscriber.—An Amateur.—Tasman.—Flute.—H. J. Hart.—W. A. McClintock.—E. M. S.—R. Bowman.—R. B. W.—J. M.—Orderic Vital.—E. H.—T. E. Clark.—Ego Nemo.

Novice. (Either direct or through an agent—preferably the latter.)—W. H. O. (Hardly worth further discussion, we think.)—A. A. B. (We should not trust them with a halfpenny, nor any similar advertisers.)—Condensed Water. (Published by Munn and Co., New York.)—A. Best. (Please send.)—J. T., Barnsley. (Any query or criticism shall appear; but it is useless occupying space simply with an invitation to others. We believe the author intends republishing; but information on this point had better be sought from him direct.)—W. J. Grey. (Thanks for your very kind offer: but we fear the matter is hardly of sufficient *general* interest.)—John Elliott. (The correspondent you mention, and others who think with him, would readily enough admit with Tyndall and Huxley that "the first step" is not yet proved, but their condition of doubt, if doubt it be, is certainly not dogmatism. The whole question is a fascinating one, but space forbids a further extension of the controversy. We began with "Transfer of Thought"; you see already where we have got to, or, rather, where we haven't got to.)—Wolfenbuettel. (A very pretty quarrel you would land us in. How long do you think it would be before the disputants on either side would be at each other's throats?)—Douglas. (It could do no harm in itself, being a simple and remarkably efficacious ointment, largely used by medical men; but it is a dangerous thing suddenly to close up old wounds of the kind referred to, especially without medical advice. Inconvenient as such ailments may be, they frequently act as safety valves, and their sudden closing may result fatally.)—J. McE. (Prussiate of potash solution, to which has been added a little nitric and hydrochloric acid. 2. Depends on the arrangements. 3. Depends on the speed. See the report of Captain Galton's experiments.)—W. Kingdon. (Methods of making oxygen gas can be found in any textbook, and several processes in our back numbers. See pp. 422, 424, 450, 475, 493, 519, 529, 547, 591, Vol. XXXIV.)—S. J. S. (Your question has been answered many times as fully as it can be. The number of cells depends on the resistance of the lamps. Most likely you will have to use about fifteen.)—Crux. (You do not say what sized lamps. However, make up a battery of 30 quart Bunsen's, and try what you can do with them. Keep battery outside the house. Read the preceding answer.)—

work without nails, which I will leave for [illegible] [illegible] [illegible] [illegible] no nails inserted [illegible] into the ends of the shelves, and [illegible] them [illegible] efficient. Now, to conclude, I would call attention to the following [illegible] of a satisfactory job of this kind:

1. Very sharp tools.
2. Careful gauging and marking out.
3. Leaving all such gauge lines on the work, sawing and chiselling inside them.
4. Level and true planing.
5. Grooves of equal depth and width.
6. Straightly cut edges and chamfers. Mark these by gauge, and plane exactly to to line. Do not fancy you can work without gauge lines.

O. J. L.

PRACTICAL NOTES ON PLUMBING.—LXXXI. LXXXII.*

By P. J. Davies, H.M.A.S.P., &c.

([illegible] from page 80.)

Service-Pipes from Street Mains.

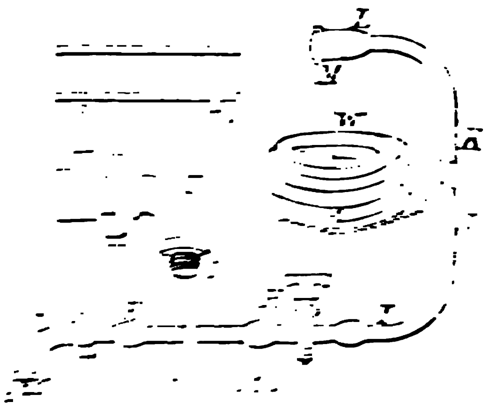
In laying these mains one uniform method [illegible] adopted. They are or should be laid at a depth of 2ft. 6in., and out of the reach of the frost.

It is always advisable when the ground has to be [illegible] to apply to the water company, as in many [illegible] it themselves, whilst in other [illegible] has to get it done. When [illegible] plumber invariably has [illegible] local board authorities [illegible] up the road.

[illegible] to deposit a sum of £1 [illegible] After the work is completed [illegible] to the satisfaction of the [illegible] is refunded.

Lead Pipes.

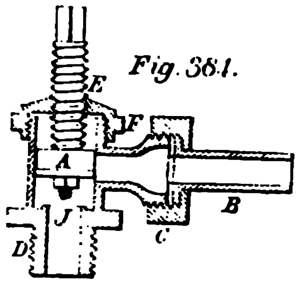
[illegible] this kind of work are [illegible] W., Fig. [illegible]

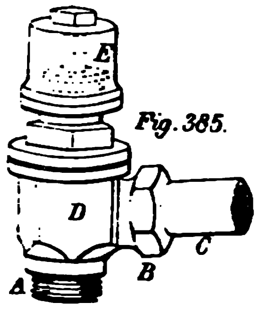


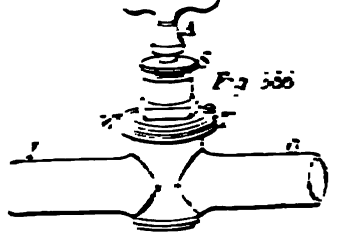
[illegible]

C is soldered on to the lead pipe, as shown at C E F. At S T U V is shown a ferrule for iron barrel screwed at C.

At Fig. 384 and 385 is shown a kind of stop-valve ferrule suitable for shutting off the water. A is the valve and J the seating, C is the union nut and B the lining, E the screw for working the valve, and F the top. In this valve it may be seen that the water has every chance of passing between the screw and the top, but on closely examining the diagram it will be seen that under the cap is fixed a leather washer, and by turning up the top part of the valve tight against this washer all chances of a by-pass is stopped. If you closely examine the end of the lining at Q, Fig. 383, and at 4 and 5, Fig. 394, you will see that the end of the lining protrudes into the union, which will prevent a solid disc being placed between the end of the lining and the end of the union. Now examine C, Fig. 384, and 6, Fig. 394. The end Q of the lining Fig. 383 is cut off at the dotted lines, and a leather washer, as shown at C, 384, and at 6, Fig. 394, can be placed between the end of the lining and the end of the ferrule or union; but suppose instead of this leather washer that a plain disc of leather be used, it will be plain that no water can pass, and should the pressure be too strong a copper [illegible] at the back of the leather [illegible]. This is a very good plan for turning off the water. I have used plumbers' unions having the end of the lining cut off as at 6, Fig. 394, for stopping off the water, [illegible] with the aid of the valve A, Fig. 384, [illegible] with the [illegible] A B and S T U V, Fig. [illegible] a valve-screw ferrule with a [illegible] at the spindle, and which is [illegible] E. In the [illegible] may be seen the method of [illegible] [illegible] is the best that can be [illegible] water companies [illegible] [illegible] This is known as the







[illegible]

passage through this cock has so many sharp corners (see section, Fig. [illegible]) it greatly adds to the power required to force the water from the main into the house, and I for one should certainly not use it, that is, if I should have to pump the water. If a valve-cock must be used, then the water companies should, for their own sakes only, use one which has a straight waterway through it, as shown at Fig. [illegible]. This also applies to ball valves. I may add that such ball valves are made. It is quite possible to fix the [illegible] cock the wrong way about—that is, to make the inlet the outlet (see Fig. [illegible] &c.). A is the inlet; should you make B the inlet, the force of water will be upon the valve, and consequently will tend to keep it closed. In such cases the cock should be reversed; but the difficulty may be got over by soldering the jumper of the valve to the spindle. But if such an occurrence takes place, keep it to yourself and away from the ears of the water company; though in point of law they cannot make you alter it, because the cock is of the screw-down kind, and the Act says nothing as to whether the valve should be a fixed or a loose one. Having fixed the stopcock, see that it is well down and fixed out of the way of the frost, and in such a position that it is accessible and can be easily got at for releathering.

The stopcock when fixed below ground should be protected with a proper cover, as shown at Figs. 387 and 388. The former is one made by J. Tyler and Sons, and is used in many parts of

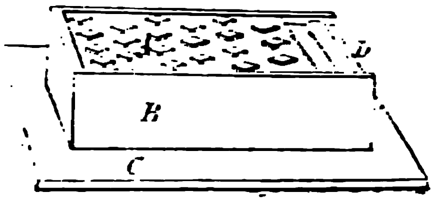


Fig. 387.

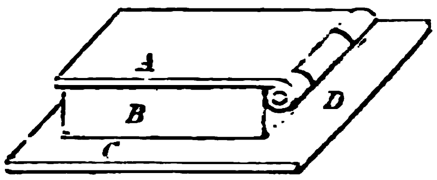
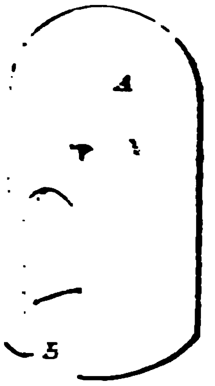


Fig. 388.



[illegible]

[illegible] In this the lid shuts below the top [illegible] and this I don't approve, because [illegible] when the frost is about, it [illegible] I have designed a box cover [illegible] Fig. 388. In this diagram [illegible] be seen that the lid shuts down fairly [illegible] and therefore dirt or frozen [illegible] the opening at any moment. [illegible] an ordinary cock or ferrule cover for [illegible] &c., in the street, and [illegible] where the earth is thrown over the same. The opening [illegible] is to receive the [illegible] Fig. 384; or for a [illegible] as at B. Wh[illegible] [illegible] is used, the cock with hay, &c., properly protected from

Building Supplies.

simply a main run, as at Fig. 383. The an is to lay the main as a permanent the house, with a stopcock on the nd near the street; the other end may to a tub, cistern, &c. But on the end, , must be fixed a ferrule and screw- :, such as shown at Fig. 390. Or if a used, an ordinary ball valve may be : soldered on. When the main is run, ppens that a garden or fire-hose supply l to be fixed. There are hundreds of orts of valves suitable for this purpose; e I prefer to fix is that shown at Fig. it at Fig. 392.

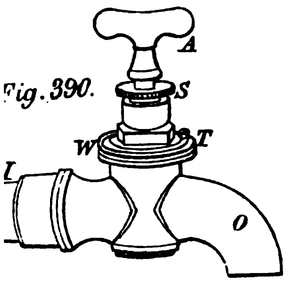


Fig. 390.

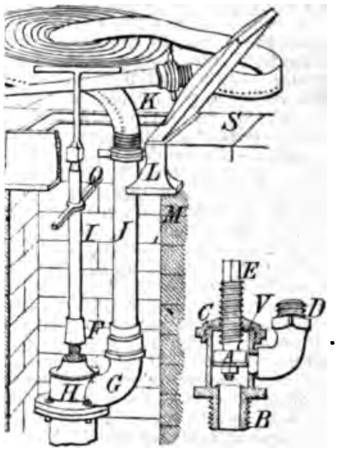


Fig. 391.

391, at H, may be seen fixed a fire alve, with hose and cover complete, the which externally is somewhat different, asily be understood. It is plainly to be the valve A is capable of shutting off , and when screwed up against the top the washer V be right, the top part of will prevent the escape of the water he spindle hole and the sides of the pindle, though some would here use a ox; but I do not, for the simple reason the valve A is shut down upon the inlet seating, the spindle and top hole not fitting too tight, the water will be allowed to run out of the stand pipe and other parts above the valve, which will prevent the stand pipes and top parts of the valve bursting in times of frost. Should the top or body of the valve be required to be water-tight at that part round the spindle, this may be accomplished by the use of the stuffing box or cup leather, or by the diaphragm fire hydrant, as shown at R A E B, Fig. 392, and Fig. 397, which also illustrates the method of fixing the same with key and hose in action. On turning open the valve, the water will force open the diaphragm and pass up the outlet E, and into the hose F D J, &c., where it may branch off at any number of branches, as shown at I J K, &c.

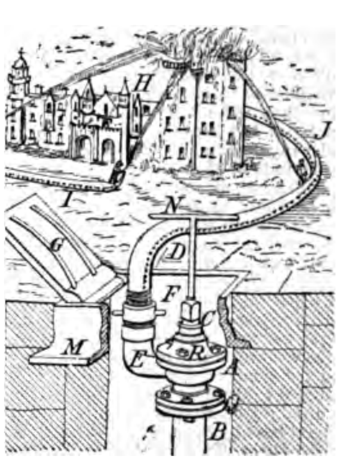


Fig. 392.

The method of fixing the valve upon the flange pipe B, and at Q, will be thoroughly understood by the plumber. All that is to be kept in view is to get suitable packing for the bedding between the flanges. I sometimes use felt, at other times canvas, old bagging smeared over with red lead and boiled oil, at other times leather or india-rubber washers. These may be purchased ready made, up to any size. I think the last named is the best when the expense is not studied, and for a superior class of work. I should add that the hose should be fixed on the union F with good strong copper bell wire, not too thick, so that it may easily be bound round. Fold it neatly round, and fix the one end, which you commence with in such a manner that the other will overlap it, then bring this end to the part where you leave off, and with your pliers fasten the two well together, or the finishing end may be fastened in the same manner that a scaffolder would fasten the ends of scaffold cords.

OBJECT-GLASS WORKING.—VIII.

(By "PRISMATIQUE.")

WE will suppose that the lenses are now roughed out fairly true as to parallelism round the edges, and due allowance made for the little alterations that will be made in their thickness in the processes of truing and smoothing. A very simple way of making smoothing tools where it is advantageous to avoid expense, and when one has plenty of time, is the following:—Models are turned of 1½in. pine, one for each curve, fitting the gauges as truly as possible, and twice the diameter of the aperture of the intended o.g. These models are a simple job to any one having a lathe; the castings should be got as quickly as possible, and directions given to the moulder to cast them *curved* face down, and to turn the models round in the sand, so that the castings may be as circular as possible. Fig. 9 gives sections of models. To avoid the expense of screw-cutting in each tool, a block of wood with a suitable thread to screw on the post, or bench screw will answer for all the tools, which, as will be seen, are flat at the back; in fact, to more simplify matters, these tools may be stuck down with pitch on the bottom of a barrel, or anything that one can reach and walk round. If these tools are *turned* up to the gauges, they can be finally trued up by casting a plate of lead in a ring fastened round the edge; this leaden plate doing duty all round by being melted and cast on each curve as the last is done with. The leaden casting does not fit when cold, but must be scraped to touch approximately, so as not to flatten or deepen the tool. If the turning of the tool surfaces is not convenient, a number of broken pieces of old files cemented into the leaden casting with pitch, and pressed on the tool, will, with patience, file it up to as perfectly a spherical surface as can be got on the lathe by turning; it is, of course, necessary to continually try the fit on the gauge, taking short straight strokes if there is a tendency to deepen the convex tool, and a circular sweeping stroke if the tendency is to flatten: with the hollow tool the reverse is needed. Many years ago this method was used in the trade; but now all tools are made in pairs, and ground true together. This is, of course, the better plan for the trade. The above directions are suited admirably for amateurs. 120 hole emery is a good size to true the lenses up to finishing tool, finally using flour emery of commerce divided into two sizes by washing. The lenses are held bare for the truing up, and the final callipering carefully done, when they are ready for smoothing and polishing.

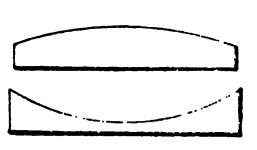


Fig. 9.

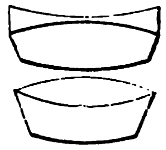


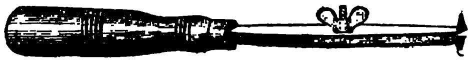
Fig. 10.

The lenses must now be cemented to a "mallet" or "back." A very simply-made back is a piece of cork cut something like a bung, with the smaller diameter exactly equidistant between centre and edge of the larger, the larger diameter the same as the lenses, the height ⅞in. The faces must be scored off to something near the curve they are to be stuck on; this I manage simply by pitching them on the lathe and scouring them out with coarse glasspaper to the required gauge. Fig. 10 is a section of cork back. To stick the glass on, a mixture of pitch boiled and hardened with finely-sifted yellow ochre, is used; this cement must be kept sufficiently plastic by heating to give to the shape of the curve with very little pressure. A good plan is to warm the tool and glass together, then have about ¼in. of the pitch already warmed and spread on the cork, and, placing the cork centrally on the lens, gently and lightly press until adhesion is complete. The pitch should be convex when warm, so as to exclude all air as the pressure is applied. Cork backs can be used for all sizes up to 4½in., but are not suitable for much larger sizes.

(*To be continued.*)

SERVICE'S POINTING KNIFE.

WE have a tool before us, patented by Mr. Service, of Bow, and sold by Messrs. John Russell and Co., Limited, of 145, Queen Victoria-street, London, which will be welcomed by the building trades as the means of a great saving of labour in pointing the brickwork of a house. It is used with the straightedge, and cuts the mortar on both sides at the same moment; it is adjustable to any required width of pointing; it performs its work in a very superior manner, and in one-half the time. The price is but 3s., and this is saved in one day's use. If it will do all that the patentee professes it will do—and we do not think his expectations are extravagant—every brick house ought to be pointed. The advantages claimed are: Saving of one-half the time occupied in cutting, and the ability to employ cheaper labour; an inexperienced person can use it, and the work is accurate and neat in appearance.



ALUMINIUM AND ALUMINIUM ALLOYS.

ANOTHER process for the reduction of aluminium has been recently patented in this country. This time the inventor is Mr. H. Niewerth, of Hanover, who also patents a special kind of furnace. The specification is No. 362, of 1883. In his first process ferro-silicium is mixed with fluoride of aluminium in proper proportions and the mixture is submitted to a suitable red or melting heat, when the charge is decomposed into volatile silicon fluoride, iron, and aluminium, the two latter bodies forming an alloy. In order to obtain the valuable alloy of aluminium with copper from this iron-aluminium alloy the latter is melted with metallic copper; the copper will then, by reason of greater affinity, unite with the aluminium, while the iron will retain but an insignificant amount of aluminium. On the mass cooling the copper-bronze and iron separate out in such a manner that both bodies can be readily isolated. In place of the pure aluminium-fluoride, cryolite, which occurs in nature, may be advantageously employed, or aluminium chloride may also be used. In the latter case silicon chloride and iron aluminium alloy are formed. Or again pure silica and aluminium fluoride, or cryolite, or aluminium chloride may be used, when pure aluminium is obtained. In the second process the compound of aluminium with chlorine or fluorine decomposed by any means into a volatile state is brought, strongly heated, into contact with a mixture of 62 parts of carbonate of soda, 28 parts of coal, and 10 parts of chalk, which is also in a highly heated condition. From this mixture sodium is disengaged, and this reduces the gaseous fluoride or chloride of aluminium in such a manner that the nascent sodium generates free aluminium from the fluoride or chloride as the case may be. In place of the above mixture other suitable mixtures which produce sodium may be employed, or mixtures may be also advantageously used from which potassium is formed. In another process the newly invented furnace may be advantageously employed, but the process may also be carried on in a crucible or other furnace. The furnace in question consists of three shaft furnaces made of fire-resisting material, two of which are made to shut by means of some contrivance, *e.g.*, a convex cast-iron cover. These furnaces communicate with the other furnace by channels, which can be closed by slides. Blast pipes are fitted to two of the furnaces, and all three are fitted with discharge apertures. Short tubes connected with a steam reservoir admit steam to the two furnaces, which are filled with some suitable fuel, *e.g.*, coke, and by the admission of the blast are blown very hot. The covers are meanwhile lifted up. The middle furnace is then charged with three charges in proper order. The first charge consists of a mixture of carbonate of soda Na_2O,CO_2 + Carbon C + Sulphur (S) + Alumina, Al_2O_3. The second charge is sulphate of alumina, the third charge a flux, preferably a mixture of the chlorides of soda and potash. This furnace must be strongly heated at the beginning of the operation; it is best to fill with coke first, and as soon as that is warm to put the charge in the coke so that it comes to the bottom with the burning coke. A mixing of the charges with coal is not excluded, but is usually not necessary.

The process then continues as follows:—The cover of the furnace is shut down, the slide drawn up, and the blast cut off. A suitable quantity of steam is now admitted which spreads itself over the glowing coke and penetrates downwards through it, breaking up into its constituent parts oxygen and hydrogen. The oxygen forms with the carbon of the coke carbonic oxide gas, while the hydrogen remains uncombined. The gases thus formed during their passage through the extremely hot coke themselves acquire a very high temperature, and at length pass by a channel into the third furnace [illegible]. The highly heated gases, carbonic oxide and hydrogen, act upon the charges so that the first charge breaks up into a combination of sodium sulphide and aluminium sulphide, from which, by means of the second charge [illegible] alumina, free metallic aluminium is formed. Passing into the melting [illegible] will melt, and, if it be drawn [illegible] thereof, will assist the fusion of the [illegible]; it is not, however, [illegible] necessary. When the gases generated in the [illegible] the second furnace [illegible] the coke having been kept [illegible] the processes are repeated.

Instead of the bimetallic sulphide, pure [illegible] may be employed, or a [illegible] it is generated, or, again, [illegible] sulphide of potash, sulphide [illegible] sulphides or analogous [illegible] the same effect alone. In [illegible] obtained in combina[illegible] sulphide. Instead of [illegible] carbonate of soda + [illegible] a mixture of alumina, sulphur, [illegible] introduced, or further the [illegible] may be replaced by alumina. [illegible] may also be formed out of [illegible] potassium sulphide, and other [illegible] may be produced [illegible] of alumina.

THE SIX GATEWAYS OF KNOWLEDGE.

At the recent distribution of prizes to the students of the Birmingham and Midland Institute, Sir W. Thomson, the president, delivered an address, of which the following is an abstract:—He said, in commencing, that if he were asked to give the subject of his address a title, he might call it "The Six Gateways of Knowledge"—that subject being closely connected with the studies for which the prizes had just been presented. The question he was going to ask them to think of was—What were the means by which the human mind acquired a knowledge of external matter? John Bunyan likened the human soul to a citadel on a hill, self-contained, with no means of communication with the outer world except by five gates—viz., the eye gate, ear gate, mouth gate, nose gate, and feel gate. Bunyan was clearly in want of a word there. He used feeling for the sense of touch, a designation which to this day was sometimes so commonly used that he could scarcely accuse it of being incorrect; at the same time, the more correct designation undoubtedly was the sense of touch. The late Dr. George Wilson, first professor of technology in the University of Edinburgh, wrote, sometime before his death, a beautiful little book under the title of "The Five Gateways of Knowledge," in which he quoted John Bunyan in the manner he had indicated. He had said, however, six gateways of knowledge, and he must try to prove that we had six senses. The six senses he intended to explain were the sense of sight, the sense of hearing, the sense of smell, the sense of taste, and the sense of touch. The sense of touch, however, must be divided into two departments. The sense of touch was very distinctly of double quality. If he took up a particular body he perceived a complication of sensations, a certain sense of roughness, but he also perceived a very distinct sensation which was not of roughness or smoothness. There were two sensations. If he dipped his hand into a bowl of hot or cold water, the moment he touched the water he perceived a very distinct sensation. That was not a sense of roughness. The sensation of the cold water was comparable with the sensation of heat, although it was opposite. Still it was comparable with the sensation of heat. He was not going to say they had two sensations in that department—a sense of heat and a sense of cold; he should endeavour to explain the sense of heat. The perception of heat and cold were perceptions of different degrees of one and the same quality, but that the quality was different from the sense of roughness. The sense of roughness was the sense of force, and the six senses which he wished to explain were the sense of sight, the sense of hearing, the sense of taste, the sense of smell, the sense of heat, and the sense of force. The sense of force was the sixth sense, or rather the senses of heat and force were the sense of touch. He had hinted at a possible seventh sense—a magnetic sense. He wished, however, in passing, to remove the idea that he was in any way supporting that wretched grovelling superstition of animal magnetism, spiritualism, mesmerism, or clairvoyance, of which they heard so much. There was no seventh sense of the mystic kind. Clairvoyance and so on was the result of bad observation chiefly, somewhat mixed up with the effects of wilful imposture acting on an innocent and trusting mind. If there was not a distinct magnetic sense, it was a very great wonder that there was not. The study of magnetism was a study of a very recondite subject. One very wonderful discovery that was made in electric magnetism was made by Faraday, and worked out very admirably by Foucauld, an excellent French experimenter, showing that a piece of copper or a piece of silver let fall between the folds of a magnetic field would fall down slowly as if through mud. Was it conceivable that if a piece of copper could scarcely move through the air between the poles of an electric magnet, that a human being or living creature in the same position would experience no effect. Lord Lindsay got an enormous magnet, so large that the head of any person wishing to try the experiment could get well between the poles, and the result of the experiments was marvellous—the marvel being that nothing was perceived. He, however, did not admit, he did not feel, that the investigation was completed. He could not but think that the quality of matter in the air, which produced such a prodigious effect on a piece of metal, could be absolutely without any—it was certainly not without any—effect, but that it could be absolutely without any perceptible effect whatever on a living body. He thought the experiment was worth repeating, worth examining, whether or not an exceedingly powerful magnetic force was without perceptible effect on a living vegetable or animal body. He thought, therefore, there might be a seventh, or magnetic, sense, and that it was possible an exceedingly powerful magnetic effect might be produced that could not be explained by heat, force, or any other sensation. He then referred to the sense of hearing, describing it as being distinctly a sense of varying pressure of air. The increase of pressure one experienced on going down in a diving bell was absolutely painful to the tympanum.

An example of graphical illustration might be taken from the recent mathematical treatise placed before the British Association by the President (Professor Cayley), who insisted very much upon the importance of such illustrations. In the language of mathematics, they had just "one independent variable" to deal with, and that was air pressure. Any one thing that varied was an independent variable. Don't let them imagine that mathematics was harsh, and crabby, and repulsive to common sense. It was merely the etherealisation of common sense. Now, in a thousand counting houses and business places in Birmingham, and London, and Glasgow, and Manchester a curve—as Professor Cayley pointed out—was regularly used to show to the eye the function of one independent variable. Most important, in Liverpool, perhaps, might be the price of cotton. A curve was used to show it, rising when the price of cotton was high, and sinking when it was low. So in the Registrar-General's tables of mortality. One of the most beautiful results of mathematics was the means of showing to the eye the law of variation, however complicated, of one independent variable.

Light we know to be an influence on the retina of the eye, and though the retina on the optic nerve, an influence dependent on vibrations, whose frequency was something between 400 million millions, and 800 million millions per second. There was a vast gap between 400 vibrations per second, and the sound of a tenor note, and 400 million millions, the number of vibrations corresponding to dull red light. the gravest light of the prismatic spectrum. With violet light we had 800 million million vibrations per second, and beyond that there was something which the eye scarcely perceived, or did not perceive at all—he believed did perceive, but not vividly—ultra-violet rays, known to chiefly by their photographic effect, but known also by many other wonderful experiments that within the last thirty years had enlarged our knowledge of light in a marvellous degree. Invisible rays of light falling upon a certain kind of glass—glass tinged with uranium metal, chameleon glass—gave to it, in the absence of all other rays, a mysterious altered colour, revealing in that way their presence. The discovery with regard to uranium was made by Prosessor Stokes, and the property was designated fluorescence. It had since been discovered that fluorescence and phosphorescence were continuous—were extremes of the same phenomenon. But there were other rays which we did not perceive by our sense of heat, and which we called heat rays. It should be remembered, however, that the rays which we called light had heating effects. Radial heat and light were one and indivisible. They were not two things, but were identical. Take a black-hot kettle into a dark room and look at it. They could not see it; but let them hold it near their face, and they would receive it by what Bunyan had called "Feel Gate." Put the black-hot kettle near the eye, and the eye perceived it—they perceived it but they did not see it. To define light:—

What they perceived was light, if they saw it as light, and if they did not see it, it was not light. Radiant heat was light if they saw it. That meant that radiant heat had differences of quality—there was radiant heat that they could see, and radiant heat. When was radiant heat light? When the frequency of its vibrations was between 40 million millions per second and 800 million millions per second. When its frequency was below 400 million millions it was not light, but was only invisible low radiant heat. When its frequency was more than 800 million millions per second it was not light, but became what they called the ultra violet rays, the actinic or photographic rays. The most subtle of their senses, perhaps, was sight, and next came smell and taste. Prof. Stokes recently said he would rather look upon taste and smell, and sight as being continuous, because they all dealt with molecular actions of matter. Prof. Stokes would rather couple those three together than he would couple either of them with the other sense. Perhaps they might know more in the future. Perhaps some of Darwin's sublime speculations might become realities to them, and they might perceive a cultivable retina all over the body. They had not done that yet, but Darwin's grand idea occurred to them as suggesting that there might be an absolute continuity between the preception of radiant heat by the retina and its preception by the sense of heat. They must be content for the present to make a distinction between the sense of light and the sense of heat. With regard to the sixth sense, that of force, he had been vehemently attacked. The physiologists had very strenuously resisted admitting that the sense of roughness was the same as the muscular sense which was experienced by a person feeling his way in the dark, and bringing his hand into contact with some obstacle. The latter was undoubtedly a sense of force, but so also, he contended, was the sense of roughness and smoothness which were experienced in feeling a piece of glass or a lump of sugar between the finger and thumb. The latter had been called by the physiologists the "tactile" sense, but that term did not much enlighten them, since tactile simply meant belonging to touch. The perception of roughness was equally a preception of force with that which had been called the muscular sense, only, instead of the place of application of the force being distant, it was distributed over ten or a hundred thousand little areas.

PENNY SCIENCE LECTURES AT THE "VIC."

THE first of a series of popular lectures on scientific subjects, delivered under the auspices of the Gilchrist Trust, was given at the Royal Victoria Coffee Hall, Waterloo-road, S.E., on Tuesday week. Mr. W. Lant Carpenter, F.C.S., was the lecturer, and had selected as his subject for that and the following Tuesday evening "Ice, Water, and Steam." Numerous brilliant experiments were performed, and were alternated with representations of natural scenery, snow and ice crystals, &c., thrown upon a screen by the oxy-hydrogen lantern. By these means, and the use by the lecturer of familiar terms and a popular style, the interest of the numerous audience was well sustained throughout the evening, and was demonstrated by the applause which greeted the experiments, which passed off without a single hitch.

Mr. Carpenter said that his subject was water, in its threefold conditions of "Ice, Water, and Steam," or its solid, liquid, and gaseous states. He proposed to treat it that evening from a chemical point of view, and on the following Tuesday from a physical point of view. All simple forms of matter resembled water in their capacity to assume these three states; the heaviest metals and the lightest gases could exist either as solids, liquids, and gases, and the condition in which they appeared was but a question of relative compression and temperature to which they were exposed. Even hydrogen, the lightest of all gases, had within the past two or three years been demonstrated by M. Pictet, of Geneva, to have a liquid, and, consequently, a solid form, under extreme pressure and cold. There were about 70 simple substances, *i.e.*, substances which could not be resolved into other more elementary forms; they included the metals and certain gases and other substances, and no alterations had been made in the list for three-quarters of a century. Water was not one of these "elements," but, as Cavendish showed in 1781, was a compound of two gases, oxygen and hydrogen. Its composition was one of the most certain facts in the whole range of chemical knowledge; we could prove it in many ways, and could both reduce water to its elements, and reconstitute it from those elements, as he should be able to demonstrate. In whichever state we found it, the composition was precisely the same. Having exhibited magnified drawings of snow crystals, he showed that all the beautiful figures they displayed were based upon six-sided forms, and these hexagonal forms also existed as crystalline prisms in blocks of ice, as Prof. Tyndall had shown by passing a beam of electric light through masses of ice. The hexagonal construction was a characteristic of the crystallisation of water, just as the cubical form characterised common salt. Returning to the subject of the composition of water, the lecturer showed that an easy way of proving its compound nature was to place the wires of an electric battery in a vessel of water, when bubbles were given off and the water slowly diminished. These bubbles, if collected and examined, would be found to consist of oxygen and hydrogen gases in never-varying proportions as to relative volume and weight, and possessing each very different qualities. If weighed, they would be found to be in 18 parts, 16 parts of oxygen and 2 of hydrogen; if measured, hydrogen represented two volumes and oxygen one, which, when combined as water were so condensed as to form but two volumes. When the water was converted into steam the relative proportions remained precisely the same; but its bulk was so augmented that a cubic inch of water nearly filled as steam a cubic foot of space. Oxygen was that element which sustained life and combustion, and constituted, as they had seen, eight-ninths by weight and one-third by volume of water. By numerous experiments with ignited tapers, sulphur, phosphorus, steel springs, &c., Mr. Carpenter showed that while substances burnt rapidly and brilliantly in a vessel filled with oxygen, the gas itself could not be ignited. That substances burned in proportion to their affinity for oxygen, and that the facility of burning was proportional to the extent of surface exposed, were facts demonstrated by numerous experiments, even lead when finely levigated burning by simply throwing it down as powder. This explained the cause of spontaneous combustion in neglected heaps of oily cotton waste, and other finely divided substances: they slowly absorbed oxygen from the air, and at length burst into flame. Hydrogen gas was very different in many of its properties. Its most remarkable feature was its extreme lightness, its weight, volume for volume, being 14 times less than air—a property utilised in raising balloons. Unlike oxygen, hydrogen burned freely; but as the audience could see, a taper was at once extinguished when put into a vessel containing this gas. The water in a shallow vessel could be decomposed into its gases not only by electrical current, but also by dropping into it, as was shown, pieces of the metal potassium, which at once seized on the oxygen and ignited, burning up the hydrogen. Or the two gases, when mixed in proper proportions in a tube, could be reunited; but for this, heat was required to start the action. Having brought such a tube near a gas jet, a loud report was heard, and the lecturer remarked that the inner surface of the tube, although previously dry, would be found bedewed with moisture. The uniting of the two gases was always attended with a violent report. Colliery explosions resulted from the impure hydrogen given out from the coal seams uniting with the oxygen in the air of the mine when a light was brought to it. They were prevented by keeping the light from direct contact with the hydrogen in the mine. When a jet of hydrogen gas—the common gas in our mains was for practical purposes hydrogen mixed with carbon, and would illustrate the point—was fed by an inner jet of oxygen gas, and ignited, it burned with intense heat. This was utilised for fusing metals—Mr. Carpenter melted and burned some steel springs in this combined jet—and also for the production of the oxy-hydrogen light by which the views had been shown that evening, a cylinder of lime being so placed that the flame rendered it white hot. This was shown on a smaller scale on the platform. Passing on to another feature in the composition of water, the lecturer explained that the difference between hard and soft water resulted from the greater chemical impurity of the former, which held lime and magnesia and other salts. For dietetic purposes the hard water was preferable, and more palatable, but for washing it was less suitable on account of the waste of soap. It could easily be softened—a ready mode being to put soda in it. Where there was doubt as to the healthiness of water, it should be filtered. This would remove all matters held in suspension in the water and aërated it, but had no effect upon those matters dissolved in it. The chief danger in water was liability to contamination by the admixture of sewage. This impurity could be entirely removed by filtering or even boiling—an excellent precaution, but could be detected in a ready manner, as was shown, by pouring into a glass of water a few drops of permanganate of potash—"Condy's fluid." If the water were free from organic impurity it would retain its characteristic and beautiful tint of reddish purple for many days, but if polluted with sewage it would quickly fade to a dirty brown colour, the period occupied by the change exactly measuring the degree of impurity. The lecture was closed by the performance of some other experiments amidst continued applause.

RELATIVE EXPOSURE WITH VARIOUS DIAPHRAGMS.*

DIAPHRAGMS, or central stops as they are frequently styled, are used for increasing the sharpness of a picture which combines near and distant objects at the margin. I will not attempt to explain everything about diaphragms in the compass of a few lines; on the contrary, the instruction will be brief and rudimentary. In the use of diaphragms do not select one of lesser aperture than can safely be adopted to produce the result—sharpness. Suppose for a test that we have tried the second stop of a Morrison wide-angle view lens of eight-inch back focus, and found that the proper time of exposure for the Beebe plate is three seconds; now the novice naturally desires to learn what relation the several diaphragms hold to each other so that he may be guided, in making exposures, to have them of proper relative duration. Be guided by the following rule: As the square of the diameter of the aperture of one stop is to the square of the diameter of the opening of the other stop, so is the length of exposure given with the first to the duration of exposure with the second.

Example:—With the lens previously mentioned and the same brand of dry plates, using the third smallest stop, the diameter of which is $\frac{25}{100}$ of inch, we found the suitable time of exposing to be three seconds. Required the time of exposure using the next larger stop, which has a diameter in the opening of $\frac{35}{100}$ of an inch: 25 squared = 625; 35 squared = 1,225, a proportion of nearly 1 to 2; therefore the diaphragm of $\frac{35}{100}$ opening will require an exposure of the plate of 3 seconds divided by 2. Result, 1½ seconds.

Problem:—If the opening $\frac{25}{100}$ requires 3 seconds, what, with the same lens, will an opening $\frac{45}{100}$ demand? 25 squared = 625; 45 squared = 2,025, a proportion of about 1 to 3¼; 3 seconds divided by 3¼, gives a result of a trifle less than 1 second.

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* By Henry Clay Price, in the *Photographic Times* (N.Y.)

BRITISH ASSOCIATION.

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ABSTRACTS OF REPORTS, PAPERS, &c.

Protoplasm and the Cell Wall.

MR. W. GARDNER read a paper on "The continuity of protoplasm through the walls of vegetable cells." As the result of his investigations of some fifty species of palms, and typical representatives of other orders of plants, he found that the cells were placed in communication with one another by means of delicate threads passing through the walls of the cells. After alluding to experiments by other investigators, he said there had been all along an accumulation of evidence giving more and more weight to the idea of the unity of the individual and the working together of its various specialised organs. The investigation showed that in each separate cell the relation between cell-wall and protoplasm was one of a closer kind than had been hitherto imagined. In every single property of protoplasm, and in the exhibition of every phenomena, the plant and the animal were shown to be possessed of a common life; and now the statement that in animal life there was a differentiation of the protoplasm, while in the plant there was only one of cell wall, could no longer be held. They were now in a position to get a clearer insight into such phenomena as the downward movement of a sensitive leaf upon stimulation; of the wonderful action of a germinating embryo on the endosperm cells, even on those which were most remote from it; of the action of a tendril towards its support; and of a series of phenomena in connection with general cell mechanism too numerous to mention.—Papers were also contributed on "The Relations of Protoplasm and Cell Wall," by Mr. F. O. Bower; on "Protoplasmic Continuity in the Florideæ," by Dr. T. Hicks; and on "The Intercellular Connection of Protoplasts," by Professor W. Hilhouse. The latter gentleman concluded that protoplastic threads connecting neighbouring protoplasts are present in such widely different and diffused structures as sieve tubes, leaf pulvinus, the pith of resting leaf-bud, and endosperm of seeds; that in the contraction of the protoplast in natural plasmolysis these threads would normally remain unbroken; and that they may serve to transmit impulses from one cell to another, acting in this way somewhat like a nervous system.—Dr. Carpenter expressed the very deep interest with which he had listened to those communications, because they went to the very fundamental conception of life that they had been gradually coming to from the days when he was taught that cells were everything. They had been coming to perceive that there are a great many forms of animal and vegetable life which never arrive at the dignity of cell form. There are forms in which there is simply a continuity of animal protoplasm, and they had been generally coming to that idea in vegetable structure. This continuity of protoplasm was really just drawing the lower forms of the two kingdoms into closer approximation one with the other. These investigations illustrated the large general views to which they were coming of the fundamental conception of life, and, on the other hand, they showed the superiority of the modern method of microscopic investigation over the old method.

Chemistry in Elementary Schools.

Mr. W. Lant-Carpenter contributed a paper on "The Teaching of Chemistry in Elementary Schools." At a recent meeting of the Physical Society he brought forward the system of science demonstration in elementary schools as practised now for some years in Liverpool and Birmingham. The essence of his system was the employment of a specially-appointed expert, who should go from school to school with his apparatus, repeating the same lesson in each. The lessons were oral, no text-books were used, and the pupils wrote notes, which were revised by the demonstrator. In Birmingham a very good central laboratory had recently been erected, where the stock of apparatus necessary for the lessons in elementary physics was kept, and it had also been fitted up for instruction of a somewhat more advanced character in physics and chemistry. A good deal of useful work had already been done by the advanced pupils and some of the teachers, under the supervision of the senior demonstrator, Mr. W. Jerome Harrison, F.G.S. Mr. Harrison had lately commenced a general system of instruction in chemistry analogous to that in physics, since chemistry for the first time now formed a part of the Government code. His idea of the proper system, however, was (1) attendance of the pupils at a cou of elementary schools, well illustrated with *viva* examinations at the commencement of each le upon the subject of the preceding one; (2) a se course consisting alternately of lectures and ex mental work, the pupil in the latter perform himself the experiments given in the forme two courses to be confined to the common elements and their compounds); (3) a third course, mainly experimental, and occupied more or less with the analysis of simple substances. As at present with physics, the first of these courses would not be entered upon until the pupil had passed the fourth standard in the three R's. Great importance was attached by Mr. Harrison to the full reproduction of lectures in notes, illustrated by rough sketches of apparatus, &c.

Astronomical Observations at High Altitudes.

A note on some recent astronomical observations at high elevations on the Andes was contributed by Mr. Ralph Copeland, Ph.D. He gave an account of some astronomical experiments made at various heights in Peru and Bolivia during the first half of the year 1883 at the cost of Earl Crawford. At La Paz (elevation 12,000ft.), the author saw stars with the naked eye, in spite of the light of the full moon, that are with difficulty seen in Europe with artificial aid. At Puno (12,500ft.), Canopus, Sirius, and Jupiter were visible to unaided vision from one to twenty-five minutes before sunset. A number of small planetary nebulæ and stars, with very remarkable spectra, were found in the southern part of the Milky Way, by searching with a prism attached to a 6in. telescope on Professor Pickering's plan. The most remarkable stars showed spectra of little more than two bright lines, one near D, and one beyond F, with a wave length of 467mm., which the author, in conjunction with Mr. Lohse, had observed in the spectra of various nebulæ; γ Argûs is a star of this type, with the addition that the line near D is three-fold. Several close double stars were discovered. At Vincocaya (14,360ft.) the solar spectrum was very much increased in brightness at the violet end. The solar prominences were seen with nearly equal ease in C, D_3, F, and Hγ. With a small spectroscope a number of lines were visible beyond H and H_2. The solar corona was not seen, nor were any lines discernible in the spectrum of the zodiacal light, although that light was sufficiently bright to be very obvious when the moon was eight days old. At Arequipa (7,500ft.) the relative humidity of the air was as low as 20 per cent., and not much higher at other stations. The author believed that an observatory might be maintained with great facility at a height of between 9,000ft. and 12,000ft., the night temperature being little below the freezing point at any season. Beyond that height an increased elevation of 150ft. roughly corresponded to a fall of the thermometer of 1° F., and a depression of the barometer of $\frac{1}{10}$in., so that at 15,000ft. very arduous winter conditions were encountered. The author thought, however, that in the early summer an experimental station might be maintained for a few weeks as high as 18,500ft. Pieces of apparatus two tons in weight could readily be transported to any of the stations up to 14,360ft.

Report on Underground Waters.

Mr. C. E. De Rance presented the report on the underground waters of England and Wales, in which it was stated that much remained to be done in regard to the circulation of underground water, especially as to the influence of variation of barometrical pressure on the volume of springs. The proportion of the annual rainfall that was absorbed by different classes of rocks was a subject that also required further examination, the quantity of water a rock would yield being no measure of the quantity of water it was capable of yielding. More observations were required as to the action of faults in acting as ducts, along the face of which water was constantly passing. The facts already obtained pointed to faults offering no obstacle to the free passage of waters which, even if locally obstructed, invariably found their way through cracks extending across the width of the fault to faults traversing thick shales and clays of any age. Permeable rocks below the permanent water level might be regarded as reservoirs, the cubic contents of which was limited by the size of spaces between the grains and the width of the fissure and cracks by which the rock would be traversed.—Mr. Baldwin Latham, in the course of the discussion which followed, referred to the observations he had been making, and said he would be glad to pay for the services of observers who would undertake the watching of certain places now under his observation. The subject was a most important one, affecting the question of public health as well as public supply.

M. Janssen on the Solar Corona.

M. Janssen gave an account of his observations of the solar corona during the recent eclipse expedition to Caroline Island. The following is a translation of the substance of his remarks:—The effects, he said, might be due either to the sun or to the earth's atmosphere or to diffraction by the moon, or to a combination of all these, and it was a difficult matter to decide between them. In 1870 he had seen, for the first time, dark lines in the spectrum *of the corona—indicating, probably, the existence of matter capable of reflecting the solar light. This* observation had been confirmed by some observers, while others had failed to obtain evidence of it. M. Janssen wished to establish the point. He thought that the failure was due to the fact that the telescopes used by most observers had too small an aperture compared with their focal length, so that the amount of light received by the slit of the spectroscope was very small; the luminosity of the corona being very feeble. M. Janssen used a lens of 50 centimètres aperature, with a focal length of 150 centimètres to form the image on the slit of the spectroscope, which was one which admitted a large quantity of light. By means of an ingenious arrangement, it was possible to observe with one eye at the spectroscope, while the other noted through the finder the part of the corona examined. M. Janssen found a complicated spectrum with many dark lines. He also verified the fact that the light from the corona is strongly polarised, and came to the conclusion that the corona appeared to have a definite limit at no very great distance from the sun. He thought that the effect observed in some photographs, in which the corona appears unlimited in extent, was due to the length of the exposure adopted. In the course of his paper he referred to the measurement by photographic means of the intensity of light, and stated that the corona was about as bright as the full moon.

Geological Age of the North Atlantic.

Prof. E. Hull read a paper on this subject, in which he said:—From the comparisons made, the conclusion was drawn that when the lower Silurian beds were being formed the originating lands must have lain over the area of the Atlantic Ocean, that being the region towards which the strata swelled out on either hand, while the replacement of the sediments by limestone indicated the position of the contemporaneous oceans over Central Europe and Western America. In a similar manner, dealing with the carboniferous strata, he showed by a comparison of sections that over the American area the sedimentary strata swelled out in the direction of the Atlantic shore, while they thinned down or passed into limestones in another direction. From these and other considerations, he inferred that throughout the Archæan, the lower Silurian, and the Carboniferous epochs, the regions of North America on the one hand, and of the British, Irish, and Western Europe, were submerged, while a large part of the North Atlantic area existed as dry land, from the waste of which these great formations had been built up, and he urged that if such were the case the doctrine of the permanency of oceans and continents, as tested by the case of the North Atlantic, fell to the ground.—Dr. Carpenter said that the conclusion he had come to from the *Challenger* expedition was that the bulk of the sea below the present sea level was to the bulk of the land somewhere about 29 to one. He thought, taking the elevation of the different continents altogether, an elevation of 1,000ft. might be considered as about the average. On the other hand, the depression of the great oceanic area below the level of the sea might be stated at an average of about 13,000ft. The elevations of land which in any way approached the same height were ridges, and one of the most remarkable facts brought out by the *Challenger* research was that there was strong reason to believe that all oceanic islands were volcanic. In all their researches they found no indication of submerged land over these areas.—Professor Blake, in opposing Professor Hull's theory, observed that there was nothing to support the argument that limestones were necessary indications of deep water.

The V-shaped Reversible Griscom Motor.—A new form of the well-known Griscom motor, which is well deserving the attention of those interested in electric engines, has been recently introduced to this country. It is called the V-shaped from the fact that the field magnets take that form; but its special features of interest are that while nearly as powerful as the familiar barrel-shaped motor, it is considerably cheaper, and is fitted with a reversing motion, remarkably simple and efficient. The new motor has only one field coil, and weighs under 2lb.; it is thus specially adapted for use in model launches, and for other purposes in which it is desired to reverse the direction of the motion. The motor can be seen in action at 2, Scott's-yard, Bush-lane, Cannon-street, E.C., where Mr. C. R. Heap, the company's representative, has a bichromate battery specially adapted to domestic purposes, such as driving a sewing machine or a fret saw—the plates being lowered into the solution by pressure on a treadle, and automatically removed from contact with the liquid by raising the foot. By this means the speed of the machine can be regulated to a nicety. The motor, for its size, is probably the cheapest electric engine yet made.

AMERICAN milling machinists are doing their best to produce a good bran-compressing machine. A satisfactory machine for packing bran has not yet been produced.

SCIENTIFIC NEWS.

WE have received recently several Science Observer Special Circulars, the contents of which, having been telegraphed to Dun Echt, have generally been given in our columns previous to the arrival of the American mail. The Science Observer Special Circular No. 41, however, contains elements and ephemeris of Comet Pons-Brooks, calculated by Mr. S. C. Chandler, jun., the latter of which may be of use to observers. The comet detected by Mr. Brooks—at an exceptionally great distance, it may be mentioned—is, without doubt, the reappearance of Comet Pons, 1812, and MM. Schulhof and Bossert have made an approximate correction of perihelion to Jan. 25·824 Berlin mean time. Mr. Chandler gives Jan. 25·780 Greenwich mean time, and the following ephemeris:–

Greenwich midnight.	R. A. h. m. s.	N. Dec. ° ′
Oct. 26.	16 35 6	53 39·6
Nov. 11.	17 27 42	50 43·4
27.	18 19 10	47 23·8
Dec. 13.	19 37 16	41 39 8
29.	21 24 37	26 51·5
1884.		S. Dec.
Jan. 14.	23 12 47	1 10·2
30.	0 27 6	25 50·3
Feb. 15.	1 10 54	39 56·6

The brightness at discovery being taken as unity, on Jan. 14 it will be 117·81, about which time the comet will be distant from the earth some sixty million miles, and will be visible to the naked eye probably towards the end of December. The comet was first seen by Mr. Brooks on the night of Sept. 1.

The Gresham lectures on "Astronomy" will be delivered next week by the Rev. E. Ledger on Tuesday, Wednesday, Thursday, and Friday evenings at six o'clock. They will consist of a course on recent astronomy and sidereal astronomy.

On the afternoon of Sunday, Sept. 2, the sun was observed to look like a blue globe by observers stationed in the island of Trinidad.

Mr. J. Firth, writing from Huddersfield, says that about 9 p.m. on Oct. 6 he and several friends saw a splendid meteor, which seemed to emerge from the south side of the Pleiades, and assuming the appearance of a monster rocket passed through the constellations Aries and Pisces, and was lost near Beta Aquarii. The meteor passed through the chord of an arc 97° in length in about eight seconds, throwing off sparks during its whole course. It was a mixture of intense white and green in colour, and a portion of the track through which it passed was suffused with a deep-blue colour.

The death is announced of Prof. Oswald Heer, of Zurich, the distinguished palæontologist and botanist, who was born in 1809, and in 1834 went to Zurich and established himself as a privat-docent. Two years later he was appointed Professor of botany and entomology. His best known work is the "Urwelt des Schweiz," which has been translated into many languages.

Under the auspices of the Technological Industrial Museum of Vienna an international exhibition of tools and appliances used in connection with wood turning will be held in that city during the first three months of the year. The exhibits will include new methods of treating the wood by which its value is increased, and also novel specimens of wood turning. Applications should be sent in before the end of this month, addressed "Technologische Gewerbe Museum, 11, Eschenbachgasse, Wien, Austria." There will be no charge for space, and customs duties will be paid by the museum.

The Midland Railway Company have determined to adopt the Pintsch system of compressed oil-gas for lighting their coaches.

The idea of connecting the Isle of Wight to the mainland by means of a tunnel is resuscitated, and it is proposed to utilise the machinery employed in the preliminary works of the Channel Tunnel.

The Zuyder Zee was recently the scene of some experiments with Holmes's siren fog-horn, to test the suitability of the apparatus for signalling by the Morse code at sea. The experiments were considered satisfactory in every way, and demonstrate the possibility of communicating by means of sound signals between ships at sea.

Capt. Urquhart, of the s.s. *Cumberland*, reports that on a recent voyage from Copenhagen to Leith he placed bags of oil over the bows—presumably in such a way that the oil would filter through—and the result was that the waves were immediately rendered comparatively harmless. The vessel had 215 head of cattle on board, and it was important to make as much headway as possible against the storm.

The manager of the chinchona plantations of Bengal, Dr. King, in his last report, states that the process of shaving the bark of the Succirubra trees has been tried in the Sikkim plantations with good results. The bark renews rather slowly; but analysis shows that the shavings are rich in quinine and chinchonidine. Where red bark trees flourish and their health and vigour can be depended on for a long series of years, the shaving process Dr. King thinks will be a very excellent one.

The *Kingston Gleaner* reports the death at Mt. Prospect, Jamaica, of a resident at the ripe age of 125 years.

The United States circumpolar observing party from Cape Barrow have arrived at San Francisco. Lieut. Ray reports that all the observations required were made.

The largest organ probably ever constructed was lately completed at Ludwigsburg, says the *Times*. It is destined for the cathedral church at Riga. There are in it 7,000 pipes, 124 stops, with pedals, &c., proportionately numerous. A very complete "swell" arrangement allows the increase and diminution of sound to be effected with singular perfection and delicacy of effects. The filling of the pipes could not be carried out by organ blowers, but is effected by machinery worked by a gas engine of 4 horse-power. The organ is 20 mètres high, 11 broad, and 10 deep (about 65½ft., 36ft., and 33ft. respectively). The largest wooden pipe is 10 mètres (32¾ft.) high, and its cubic contents are 70·6 cubic feet; while the smallest pipe is only a centimètre and a half high (little more than half an inch), and is attached to the greatest one. By referring to p. 524, Vol. XXX., it will be seen that the large electric organ at Garden City, Long Island, contains 7,031 pipes and 115 speaking stops; but as that instrument is distributed in four parts of the cathedral, we suppose the Riga organ will henceforth rank as the largest in the world.

American Machinery and Tools.—Churchill and Co., of Cross-street, Finsbury, E.C., have issued a new catalogue of American machinery and tools, illustrating the manufactures of more than 130 firms. The catalogue is really a useful volume, consisting of 206 quarto pages full of illustrations of various machines and tools of more or less interest to everybody, but of special interest to those of our readers who write to ask where machines or tools to do this or that can be purchased.

Weight of Timber.—The following is the weight of seasoned timber per cubic foot, in pounds:—Apple tree, 49; ash, 50; bay-tree, 50; beach, 51; birch, 48; box, 60; cedar, American, 30; Lebanon, 35; cherry tree, 42; chestnut, 40; cork, 15; ebony, Indian, 70; American, 80; elder, 42; elm, 39; fir, Dantzic, 35; Memel, 38; hazel, 40; hornbeam, 48; larch, 35; lignum-vitæ, 70; logwood, 55; mahogany, Honduras, 40; Spanish, 55; maple, 47; oak, English, 50; American, 47; Baltic, 46; pine, red, 40; yellow, 33; poplar, white Spanish, 32; sycamore, 37; teak, Indian, 41; Moulmein, 45; Johore, 70; African, 60; wainscot, Riga, 38; walnut, American, 35; Spanish, 43; willow, 30; yew, 50.

New Clock at Washington.—A clock of peculiar construction has been manufactured for the United States Signal Service Bureau at Washington. The case is of brass, and allows the swing of a pendulum 39in. long; it is air tight, and admits of the air being exhausted, and the movements run in a vacuum, thus obviating any possibility of variation due to atmospheric changes. An electrical attachment is connected with the movements, by means of which the clock is wound as it runs, so that there is not the usual liability to variation arising from the differing conditions of the mainspring. This is accomplished by alternately breaking and closing an electric current. The motion thus obtained and the power of the current are used to re-wind the spring by means of a worm and other mechanism. The winding keeps exact pace with the running, and the slightest deviation from this standard is shown on an indicator. The train is jewelled, and is therefore little affected by friction.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

DAYLIGHT OBSERVATIONS OF STARS — PRACTICAL WORK AND THE LIVERPOOL ASTRONOMICAL SOCIETY — "THOUGHT READING" — LOW BAROMETER — "A HEAVY BLOW, AND GREAT DISCOURAGEMENT" — MEASURING THE SLOPE OF HILLS—CLOUDY OBJECT GLASS —ROMSEY OBSERVATORY—SEEING THE SUN IN A POCKET TELESCOPE —CENTRE OF GRAVITY OF THE EARTH AND MOON — ANOTHER QUACK ADVERTISEMENT — THE SELENOGRAPHICAL SOCIETY—SIN AND DEATH—SHAKESPEARE AND THE STARS.

[21898.]—Will Mr. Franks (letter 21851, p. 86,) forgive me for saying that I put no "construction upon his daylight observations of stars" beyond that of the implication that they were very interesting; and that I merely pointed out that they were capable of repetition, to some extent, with very much smaller instruments than his, as an encouragement to young observers to follow his excellent example?

And, apropos of young observers, I am sincerely gratified to learn from Mr. Espin's letter (21855, p. 86,) what excellent work is being done by the Liverpool Astronomical Society, and how effectively that Association is working in directing the energies of its members into profitable channels. The amount of telescope power running to waste in this country is pitiable; and every astronomer must welcome such well-directed efforts to utilise it, and wish godspeed to those who are, however unassumingly, doing such good service to science.

As "Sigma" (letter 21856, p. 87) is so indignant with "Kappa" for the assumption that a trick may possibly have been performed on Mr. Carter, perhaps he will excuse me if I narrate a simple personal experience of my own in a cognate matter. A good many years ago I was considerably struck with an exhibition of (what was absurdly misnamed) "electro-biology." The operator invited members of the audience to subject themselves to the influence which he exerted, or professed to exert; and such as volunteered to do so were ranged on a platform, and, each one seated in a chair, were charged to maintain rigid silence and gaze intently at a coin or disc. After this had gone on for some minutes, the "electro-biologist" made certain passes over the eyes and forehead of his subjects, and then seizing their hands successively, and looking them straight in the face, told each one that he had forgotten his own name. In more than one instance, the person so addressed declared that he was quite oblivious of his name; and these susceptible patients were set aside for further experiments of a like nature. I went to see this exhibition more than once, and certainly had my faith slightly shaken by the reappearance upon the platform of the faces of certain youths whom I had previously seen under the "influence" of the lecturer. However, I saw—or thought I had seen—enough to render the matter worthy of serious investigation, so I commenced to experiment myself. I rather failed to reproduce the marvels of the exhibitor, but I did find one subject, a bright boy of some 11 or 12 years old, upon whom my operations produced a remarkable effect. "You cannot," I asserted, in the orthodox fashion—"you cannot remember your own name." "Well," was the response, "it is a most wonderful thing; I never forgot my name before in my life, but I cannot remember it now!" Much impressed with such a result, obtained upon a relation of my own, whom I, of course, knew intimately well, I continued my experiments, and finally, taking a silver-gilt filagree paper-weight, I threw it along the floor, and exclaimed, "N——, that is a toad?" "No!" was the instant reply, "it is not: it is a frog—I saw it 'jump.'" After my subject grew up he left England, and for some years I used to quote his case as one affording unimpeachable testimony to the reality of the phenomena I had witnessed. I never believed that I had had any further share in the matter than that of persuading the lad that my manipulations had produced an abnormal intellectual condition in him; and that he was in fact in a self-induced semi-hypnotic state; but I *did* believe sincerely that he was in such a state. Well, when we met on his return home, we naturally discussed old times, and among other reminiscences I revived was that of our bygone experiment in "Electro-biology." "Do you remember my making you forget your name, and take a paper-weight for a frog?" I asked. "Perfectly!" was the answer. "I remember the whole thing: *but I was only humbugging you all the time.*" Now this was no boy taken out of the streets at eighteenpence a night to perform on a platform, but a young English gentleman, whose pedigree may be read in "Burke"; and, therefore to appeal to mere "respectability" or social position, as affording a guarantee against deception in such a matter, is simply idle. The fact is that young people regard it as great fun to take in their elders, and "thought reading" and the like as a pious fraud to be legitimately committed for the sake of amusement. Moreover, the love of admiration and approbation is so innate in all girls, that they will do anything which does not involve an outrage on their modesty to win it. As far as I have been able to test the evidence advanced to support the idea that thought reading (in any legitimate sense) is possible, I am fain to confess that the Scottish verdict of "Not Proven" represents the result of my investigation in its most favourable possible aspect.

Let me thank "T. R." (letter 21869, p. 90) for his interesting record of a most abnormally low reading of the barometer. I am far enough away at this moment from my meteorological records; but on my return shall look curiously at that for January 19th, 1873, to see whether the atmospheric pressure at my station in any way approached that recorded by your correspondent.

I have some idea that it was in the tornado the description of which "Nun. Dor." extracts from the *Scientific American* (in Reply 50765, p. 91) that the Yankee sailors "stood in single file holdin' each other's hair on—only the hindermost critter was bald, and so didn't need it!"

"Far" (query 51800, p. 96) wants some simple form of clinometer. I fancy—but am not sure—that he can get what he wants at Buck's, the great tool makers, on Holborn Viaduct, London.

I do not suppose that the crown and flint lenses of "H. C.'s" object glass (query 51809, p. 96), were ever cemented together. It is quite unusual to cement the objectives of astronomical telescopes. He may try cleaning with a little pure alcohol on a cotton wool pad, and drying them with perfectly clean washleather, taking particular care to replace them in the position they originally occupied and with the same faces in apposition. Should the spirits of wine fail, he must send them to an optician to be repolished.

It is very difficult to answer query 51815, p. 96, without more data than "T. R." gives. Had he not better make a drawing to scale of his telescope and mounting, and surround it with an outline building? Allow, at least, 18in. clear between its walls and the eye end of the telescope, and 6in. from that part of the dome to which the dewcap approaches most nearly when the telescope is turned round on either of its axes.

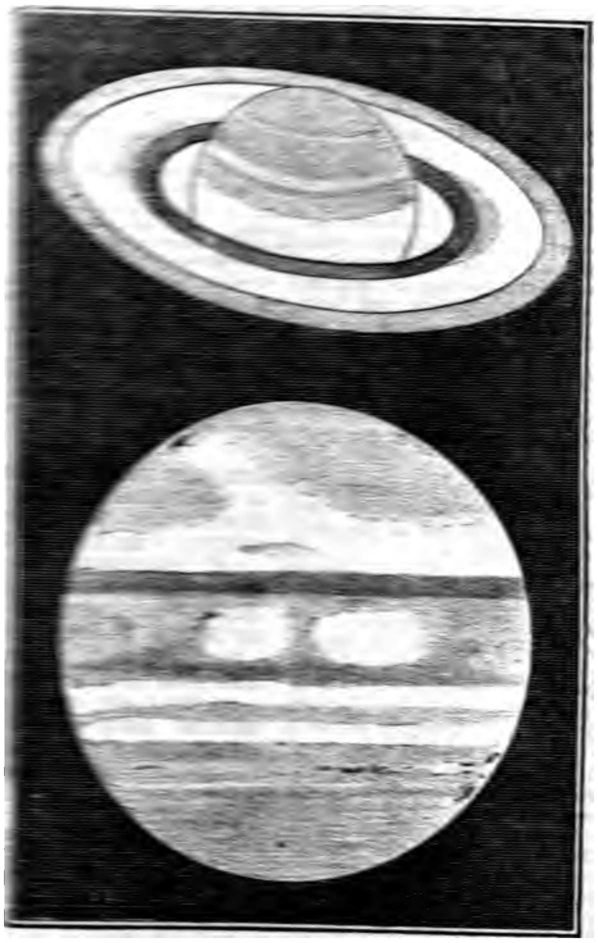
"Warragul" (query 51855, p. 97,) should take his telescope to the makers, and get them to put him on a very dark "London smoke" eyecap. Then he will be able to perceive some of the larger sunspots, should there be any on the sun.

Writing some 217 miles as the crow flies from my own library, I cannot answer query 51861 (p. 97) off hand. If, though, "P." will hunt through your last volume, I am sure that he will find that I gave the distance he asks for not very long ago in one of my letters.

It needs no ghost to rise from the grave to indicate the member of the Brompton Mutual Admiration Society (Limited), who penned the *Times* paragraph anent the reduction by Dr. Schuster "to a decimal point" of "the exact constitution of the Sun." "Scientific News," p. 105). Doubtless, we shall soon have Dr. S. himself proclaiming in print that the "non-elementary character of the elements has been irrefragably shown by that eminent astronomer (!) Smith," and so on. One hardly knows whether to feel pity, contempt, or indignation at the conduct of the (grossly miscalled) "leading journal," in lending its columns to this most impudent and persistent system of quack advertising.

I have a notion, well or ill founded, which I may mention in connection with letter 21878 (p. 106), that the Selenographical Society has collapsed altogether. I fancy that it expired soon after doubling its annual subscription.

[illegible]



[illegible] W. S. Franks.

JUPITER WITHOUT HIS SATELLITES.

[illegible] A letter on this subject from the [illegible] the morning of the [illegible] off the disc of the planet; the [illegible] See [illegible]

G. J. W.

THE RED SPOT ON JUPITER.

[illegible] our old friend, the red spot [illegible] is probably the most interesting stage of its existence. On the reappearance of the planet after its conjunction with the sun, the spot was somewhat anxiously watched for here, but owing to bad weather nothing decisive could be ascertained of its existence until the morning of August [illegible], when the spot was distinctly visible, [illegible] extreme faintness, and at times even a [illegible] could be made out. It was estimated [illegible] the central meridian at [illegible]. On the same morning it was also seen at Bristol by Mr. W. F. [illegible], and estimated central at [illegible]h. 48m., there being thus only a difference of one minute between the two times.

The red spot was next observed on Aug. 26th, when at [illegible] it was seen distinctly, though very faintly, several times near, and almost up to, the preceding limb of the planet. On the morning of Sept. [illegible], Sig. A. Ricco, of the Palermo Observatory, failed to detect any signs of the spot, the place where it formerly was appearing very white. It was, however, again seen here on the central meridian on Sept. 14th at 15h., my note saying:—"The spot is by no means so very faint or difficult [illegible] when the spot would be visible in England, and at [illegible] it was estimated to be on the centre. [illegible] was very good, better than on the 14th, [illegible] the spot was then described as "excessively faint and [illegible] rarely visible distinctly in outline, and its colour, too, is scarcely at all apparent." [illegible] has not since been examined here when the spot would be visible on the disc. The red spot would therefore now appear to be in the last stage of its existence, as a visible object, and deserving of the most careful attention. It is to be hoped that some of our friends furnished with large apertures, with which it may still be visible for a considerable time longer, as my observations were only made with a 5½in. Calver and a power of [illegible], will look up this interesting object, so that we may get as complete a record as possible of the time and manner of its disappearance. Its position is well marked by the curious bay or indentation of the dark south equatorial double belt opposite the spot, and which still remains a striking and prominent feature of the planet. From Mr. Marth's ephemeris, the red spot may be expected on the centre at about the following times:—

	h.	m.
Oct. 12	18	1
„ 13	13	52
„ 15	15	30
„ 17	17	8
„ 18	13	0
„ 19	18	46
„ 20	14	38

A. Stanley Williams.

West Brighton, Oct. 6, 1883.

TRANSFER OF THOUGHT.

[21903.]—First let me disabuse "Kappa" (21892, p. 110) of two delusions. He thinks I am on the road to spiritualism, and that I have only recently started. The experiments and observations I have described were commenced 22 years ago, and my mind fully made up at least 20 years. This is neither the first nor second discussion on this subject in which I have taken part in these pages. As to spiritualism, of course I am a spiritualist as opposed to the materialist; that is, I believe in the spiritual nature of man, and of all existence in fact. But as to what is no doubt meant—that is to say, the "medium" stuff—so far from my being on the way to it, I was, to some extent (owing to my mesmeric acquaintances) mixed up with it when it first was introduced in England, and I have all along maintained that gress was not made: it is, however, almost hopeless to expect the brake question to be settled until the bill which has been twice "shelved" in the House of Lords becomes law.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, September 22nd.

THE PARKER-SMITH AUTOMATIC SCREW BRAKE.

[21922.]—I REGRET to see, considering his alleged impartial views on the brake question, Mr. Stretton is so unfavourably inclined to mechanical brakes. I am afraid few people will agree with him in his assertion that mechanical brakes have had their day, and must now give way to better inventions, though he omits to mention what they are. It is correct that the chain and Fay and Newall's brakes are gradually being discarded in place of more generally adopted systems, though whether there has been much gain in reliability or efficiency is not so certain. There are many great and urgent requirements in a continuous brake having regard to the usual and convenient methods of railway working, that the present forms of air and vacuum brakes do not possess. The Westinghouse Automatic brake no doubt has shown better stopping results, and quicker application than the vacuum systems. Though it is unquestionably an ingenious price of mechanism, when we consider that all its component parts—viz., reservoirs, main and auxiliary, triple valves, brake cylinders, pistons, cocks, &c., are subjected to a pressure of 80 to 100lb. on the square inch, and the careful supervision necessary to keep such intricate machinery in working order, we must be more than reminded that the *simplest* means of securing a result is the best. The method of applying the brake by *lowering* the pressure in the brake pipe, while admitting a more certain automatic action in the event of a train separating, is an arrangement liable to constitute an element of danger. Indeed, fatal accidents have occurred both at home and abroad through the brake suddenly applying itself without apparent reason, and resisting all attempts of the driver to move his train. This necessitates the release valves being opened to allow the air to escape from the brake cylinders, an operation which may take from 10 to 15 minutes. It will be seen that it is advisable for any railway company using this brake to have the block system rigidly enforced to reduce the possibility of collisions arising from this cause. Again it is possible for a driver to start his train without the knowledge that all the brake pipes on the coaches are properly coupled up and the taps turned. He may start in the belief that he has control over the ten vehicles composing his train, to discover, when there is an urgent necessity for a sharp pull-up, that the shunter has omitted to open the taps between the third and fourth carriages, and therefore two-thirds of the braking power is not available. It is true that this last defect was sought to be remedied by substituting valves in the couplings in place of the taps; the effect of coupling up the hose piping causing these valves to automatically open and close when uncoupled. They, however, were not found reliable, and those companies that had adopted them at once resorted to the old and present form of taps. It will be seen, therefore, that the difficulty still exists, and apparently can only be met by careful inspection and supervision. Though no doubt the Westinghouse brake has shown good results, as Mr. Stretton has frequently pointed out, your readers will readily perceive that there are several improvements required before it will fulfil (besides those of the Board of Trade) the conditions our engineers require of a continuous brake. In Mr. Parker-Smith's screw brake these difficulties are practically removed; a simple chain taking the place of the brake pipe, hose connections, and taps, it follows that nothing but the actual rupture of this chain would cause the brake to apply itself when not intended, and seeing that none of the braking pressure is transmitted through it, this contingency is hardly likely to occur. I have explained before how the automatic action in the event of a train separating is effected, and that to release the brake would merely require the chain to be tightened. In the second place, as the brake is normally *on*, the train at starting cannot be moved more than the distance represented between two or three revolutions of axle (about 30ft.), unless the brakes are taken off. This is of course a practical test that the brake is in working order throughout its entire length.

The vacuum systems employing for their braking force the unbalanced pressure of the atmosphere, the excessive strain on the apparatus imposed by the air pressure system is avoided. It has however the disadvantage of a slower brake action with heavier and somewhat cumbersome apparatus. A serious objection in most of the vacuum systems is also the fact that uncoupling the carriages for the purpose of shunting, &c., causes the application of the brakes, preventing the carriages being moved till the brakes have leaked off. This otherwise *inconvenient period* has been reduced to two minutes by providing a leak hole in the piston. Whether or not, in the event of a detached portion of a train being automatically pulled up on a heavy gradient, this period would be found sufficient to find and apply scotches to the wheels, as stated by the advocates of the system—is a question I would prefer leaving undisputed, than attempt to test it by personal experience.

With reference to the Heberlein brake mentioned by Mr. Stretton as having been tried on several railways and found, though received favourably in Germany and Switzerland, to be unsuitable to English railways, it is described as an automatic friction brake, permitting a steel friction wheel to fall against a chain to be wound round a drum, attached to and parallel with the steel friction wheel, pulling the brake-blocks against the wheels. In practice, however, it is found that all the brakes on a train do not come into action simultaneously, also, owing to the friction wheels skidding while the brake remains on, considerable wear and tear takes place. Another disadvantage is that the brake must be always fully on or off, and is therefore not easily regulated. From all these defects the automatic screw brake as designed by Mr. Parker-Smith is absolutely free. It is essentially a *mechanical* brake, and not a chain brake as many confound it with. The limit of graduation in a screw being undefinable, any desired braking pressure may be maintained for an unlimited period. Another important advantage is the very quick application that can be obtained by the screw brake. Less than three revolutions are sufficient to apply full braking power. It is stated by the advocates of the Westinghouse system that their brake can be applied in one and a quarter second. A train travelling at 60 miles per hour will advance in that time 110ft., whereas three revolutions of the axle means an advance of only 30ft. Mr. Stretton informs us that though many engineers have inspected the screw brake, none have as yet adopted it. Although I have made several inquiries, I am unable to find a single *practical* objection that can be sustained against it: in fact all those who have inspected it in an impartial manner, are struck with the ingenuity and perfection of the invention. I have heard that several of the Continental countries are arranging for its trial and adoption. A conference of Continental engineers not long since decided that after an exhaustive and extensive trial, the fluid systems were unsatisfactory. Nothing further will be done till a reliable mechanical brake is in the market. I think with "K. S. T.", page 64 (our Editor kindly permitting) if Mr. Parker-Smith would give us a sketch and description of his brake mechanism, &c., the readers of the "E. M." would be in a position to decide on the important question of continuous brakes.

Imprimatur.

MR. STURROCK'S STEAM TENDERS ON GREAT NORTHERN RAILWAY.

[21923.]—CORRESPONDENTS have once or twice asked for some information respecting the once celebrated steam tenders introduced by Mr. Archibald Sturrock when locomotive superintendent of the Great Northern Railway, and applied to the engines used in the heaviest goods traffic. None has, however, been forthcoming: so, as the subject is one of considerable engineering interest as an important experiment in locomotive practice, I venture now to send a few particulars, mostly obtained from a friend formerly in the locomotive department of the G.N.R.

It appears that, about the end of 1863, Mr. Sturrock determined to increase the capacity of his goods engines by adding a pair of cylinders to the tenders, and applying the power to the tender wheels. The engines were of the standard type then employed for goods traffic, having six wheels coupled, 5ft. diameter, and cylinders 16in. by 24in. One of the G.N. goods engines of this class, built by Wilson, of Leeds, is illustrated in Clark's "Railway Machinery." Several engines and tenders were accordingly altered at the company's works. The fireboxes were enlarged, a second regulator placed in the dome, and the feed pumps arranged for pumping hot water. The tenders were fitted each with a pair of cylinders 11in. diameter, with a stroke of 17in. The cylinders were placed between the first and second pairs of wheels, inside the frame plates, and all six wheels were coupled by outside cranks and side rods. There was also a kind of surface condenser in the tank, made of thirty 2in. tubes, for heating the feed water, which it did to boiling point very speedily. The first engine thus fitted was No. 391. It was set to work on the London-Peterborough division, and was soon followed by Nos. 393 and 394. These engines proved themselves capable of hauling 40 to 45 loaded coal waggons on the main line over ruling gradients of 1 in 200, and as many as 60 on the Lincolnshire line, which is nearly dead level, the loads for an ordinary engine being 30 and 35 respectively. This result was deemed so satisfactory, and the steam tenders appeared on the whole so successful, that the company determined on having 70 new engines built on the same system. They were constructed by several different makers, the contract price being £3,750 each. Their numbers were 400 to 469; they had 16in. cylinders on the engine and 12in. cylinders on the tender, each pair of cylinders driving six coupled wheels. The engine weighed 35 tons, and the tender 25 tons, in working order. A complete revolution had apparently set in in the working of goods traffic, and sanguine expectations were entertained as to the results.

Before, however, the whole of the 70 engines had been delivered, the company had reason to believe that all was not so satisfactory as it had seemed to be. Grave doubts were suggested as to the economic value of the steam tenders. The cost of repairs was found to be excessive, as, in addition to the dust knocked up by the engine proper, the sweepings, &c. of the footplate found their way into the tender-motion, thus causing extreme wear and tear. Unfortunately, too, they never received really fair play, for a dispute arose with the engine-drivers, who claimed an extra sixpence a day for working them, owing to the greatly-increased loads they drew. This demand was rejected by the directors, and then the men, in retaliation, systematically neglected and ill-used the engines, so that the repairs bill mounted up inordinately. An attempt was made to restore the equilibrium by distributing the extra expense over the locomotive stock generally; but this created dissatisfaction, and in the end the directors were forced to discontinue building the steam tenders; indeed, many of the 70 already mentioned as under contract were ordered to be stripped of their tender working gear before they left the builder's shops. In 1866 Mr. Sturrock resigned, and was succeeded by the present locomotive superintendent, Mr. Patrick Stirling, who soon "improved off the earth" every remaining steam tender, and rebuilt the engines with 18in. or 19in. cylinders.

Such I believe to be an accurate history of a very important experiment in locomotive engineering, and I hope it may be interesting to readers of the "E. M."

Wellington, N.Z., July 17. **C. R. M.**

REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51203.]—**Music.**—I am obliged to Mr. W. J. Grey for his notice (p. 111) of my request; but I can only wonder what my departed ancestor would have said to such a reply. Can Mr. Grey point out in what way his use of organ stops "full to fifteenth," will produce consecutive fifths? Is there, for instance, a passage in the "Messiah"? Mr. Gray must forgive me, but he appears to have missed the point of my query, which, stated tersely, is, "What have the pitches of stops to do with harmony?" If Mr. W. J. Grey will analyse any given passage from the works of "my departed ancestor," using all the stops in the biggest organ ever made, he will find that there is nothing "wrong about the rules" of harmony, but some misconception at Elswick.—G. F. H.

[51203.]—**Music.**—Consecutive fifths are forbidden because they are not pleasing to the ear, as may readily be proved by trial and comparison with other intervals. Octaves are not unpleasing, but are forbidden in four-part harmony, as Richter says, because "the doubling of a note, although it adds one voice to the harmony, does not add any new interval to the chord," so that the effect of four parts is lost. Whole passages in octaves are common enough. On the organ we not only get consecutive octaves, which are not forbidden in this connection, but also fifths, and the most extraordinary conglomeration of notes when the twelfth, mixture, and sesqui-altera stops are drawn. For instance, the common chord of C gives in addition to the principal notes C E G, G G sharp B C D E, all sounding at once, and repeated several times over in different positions of the scales above the principal notes; yet the effect is good. To understand why, read the treatise of Helmholtz on "Harmonics," and on the cause of the different quality of tone in musical instruments, for instance, the flute, oboe, clarionet, or fiddle. When a note is sounded, the pipe or string not only vibrates as a whole, but also in several distinct portions, so that the note produced is not really a single note, but as it were a chord in which the principal note is sufficiently powerful above all the rest to prevent the harmonics, as they are called, being heard as notes, while the harmonics, by their relative number and position as to pitch, give the specific [illegible] to the instrument. By proper means, which we cannot discuss here, they can be heard and played on the scale in their several positions. A tuning-fork has very few, if any, harmonics, and its tone is sweet and pure, as it is called; an oboe has [illegible] harmonics. The harmonics of a pianoforte string can be heard by striking a note and allowing the sound to die away: as the principal note weakens, others will be faintly but distinctly heard. Now, the so-called mixture stops of an organ are for the purpose of adding such extra harmonics to those due to the foundation stops themselves as have been found in practice to produce a good effect. The discoveries of Helmholtz afford an explanation of the reason. These mixture stops can only be used with others loud enough to cover them; if used alone or with soft stops the noise is horrible. May I be allowed to remark that it might be well for us all, and especially for those who have the great advantage of being connected with science schools, to think that it may, after all, be possible that rules of long standing and universal acceptance are correct, even although we do not understand them and think "there is something wrong about them."—Emeritus.

[51203.]—**Music.**—Mr. W. J. Grey presumes that there must be "something wrong" about harmony rules concerning consecutive fifths and eighths, because he finds that by drawing certain stops on his organ such progressions are made with *very good result*. He does not consider the circumstances, however, which make the result satisfactory; but takes for granted that the consecutive intervals are of the *same nature* as those forbidden by the *established* rules of harmony. As a matter of fact, every musical sound that is produced gives out the intervals of an octave, a twelfth, a fifteenth, and innumerable other harmonics which become more and more feeble as their distance from the prime sound increases. The use of mutation and mixture stops is neither more nor less than an attempt to give greater power and brilliancy of tone by imitating the more important of these harmonics, and the satisfaction derived from their use depends upon the *amount of prominence* given to them. The study of harmony presume the parts to be of equal importance; and, under these circumstances, the ear is offended by consecutive fifths. Let the "composition pedal" teach Mr. Grey a lesson. Let him observe that, when it is pressed down four stops are in use besides the twelfth; so that the stop which is responsible for the forbidden fifths is (in *power*) equal only to about the fifth of the entire combination. Consecutive octaves forbidden by the rules of harmony and such octaves as are produced by combination of organ stops, are even more distinct from each other in their nature than the two kinds of consecutive fifths. If, however, these observations are sufficient to satisfy Mr. Grey that the rules of harmony concerning consecutive fifths have "nothing wrong" about them, he may, perhaps, feel convinced that it is possible for the laws of consecutive octaves also to be genuine, without going into them now. The answers (on which Mr. Grey commented) to the original question put some weeks ago, were all to the purpose. It is evident, from his comments, that Mr. Grey is not a musician, although he may have *read through* a work (perhaps, several) on harmony.—Teacher of Harmony.

[51253.]—**New Zealand.**—In answer to "Old Subscriber," I should recommend him to the north island, though not so far advanced as the south island, as the more agreeable climate. He should go to one of the larger towns, Wellington or Auckland for instance, where he is more likely to obtain the repairing jobs he prefers. As soon as possible on arrival, I should advise him to invest his £1,000 in two separate amounts on freehold mortgage security. This will bring him in some £80 to £100 per annum, and as living is cheap, will enable him to board comfortably during the period the mortgage is running, say 3 or 5 years. He would thus be enabled in the intervals of his repairing jobs, to look round and see the requirements of the colony; and by the time his capital is repaid will see how he may more advantageously invest it in the erection of small houses in a growing town. Many have done well in this way. The small houses are built entirely of wood with brick chimneys, one story high, and roofed with galvanised corrugated iron.—Imprimatur.

[51253.] — **New Zealand.** — In replying to "Engineer," I would personally select Auckland in preference to Otago, as the best place for an engine fitter. I am afraid my experience will not allow me to say whether a lady could establish a school for young children with success, though I see no reason why she should not in a large town. There is, however, a very complete system of state education, and in the smaller towns is attended by children of all classes, the fees being very light. As suggested to "Old Subscriber," I would not advise you at first to start any speculative building, but as you possess a knowledge of joinery, you would have no difficulty in procuring contracts. Ten per cent. can be safely got for sums of £200. If you go by sailing vessel, I should certainly recommend you to take all the clothes you can, though avoid any great excess of luggage. Cloths and tweeds are manufactured in N.Z., suits being sold at similar prices to England, but the quality is not so good. A good supply of moleskin trousers you will find very useful. N.Z. is considered a very healthy colony; notwithstanding the scarcity of doctors, the mortality is very low. As regards its suitability for neuralgic subjects, I don't think I ever met any, though, on reflection, that may be evidence that the colony *is* good for them. You might apply to the New Zealand Steam Shipping Co., for post of an assistant engineer; otherwise I don't think you can do much to employ your time on board ship, beyond making samll articles such as picture frames, &c., for your own use.—Imprimatur.

[51253.]—**New Zealand.**—I will preface the information I am (at considerable cost) able to give about N.Z., by stating that the whole population of this colony is somewhere about half a million, counting Maories and all. The whole of the land is mountainous and broken, with the exception of one or two plains of large extent. The soil in the northern parts is of the most worthless description, and fully justifies the remark made by Commodore Wilkes, of the U.S. Navy, "that the scientific expedition under his command left its sterile shores without regret." My remarks applying to the colony as a whole are founded on experience purchased in Auckland. First, as to climate, they plead guilty to 56in. of rainfall, while in the Thames valley we get about 23 or 24; and I never yet met with anyone here who wanted more. For nine months the showers are at short intervals, and for three the intense heat dries up the grass and cracks the sterile clay into deep fissures. In the winter the cold, bleak winds that howl and rage bring rains from either ocean, and those residents who have been there for a few years suffer as much from the cold as we are supposed to in England. The climate is so enervating from the excessive humidity and heat that they—i.e., the old identities, coddle their bodies up with wraps in weather that the average "new chum" thinks fairly warm, and it is difficult for a new chum to realise the undoubted fact that their sufferings are real and not make believe. As for wind, why it is *the* pest. No, we will say *one* of the pests of N.Z. The dull, lowering days of winter are made lively by the sub-tropical gales that do their best or worst to overturn your house, and houses (wooden ones) are rocked to that extent that the inmates are oftentimes afraid to go to sleep for fear of the momentarily expected overturn; brick houses are too expensive and *too damp* to be obtainable by middle-class folks. Shelter trees are about the first things planted by the squatter, and blue gums having had their day are being supplanted by pines; but I think unwisely, as gums, from the rapidity of their growth and the scent they exhale, are undoubtedly valuable trees in such a swampy land. The following extracts from a contemporary publication will perhaps be taken as an endorsement of facts I have stated:—"The wind is always blowing here. I don't think we have had a calm day since I landed. It is very unpleasant, but I think it makes the climate more healthy. The great number of marshes would cause fever and ague if the wind did not blow the miasma away." From the broken and mountainous character of the colony (regarded as a whole), it will never be more than a poor member of the Australian colonies. There are doubtless tracts of very fertile soil; but the majority is utterly unfit for the production of corn, and even grazing lands can only be *made* at enormous expense. The excessive rainfall so floods and supersaturates the soil, that the soluble salts which form the essential, and, indeed, vital portions of the food of economic plants, are washed out to sea, and ferns are the characteristic flora. Of useful timber trees the number is exceedingly limited; but in this respect New Zealand is in no worse plight than Australia. The timber of the Kauri pine is the one wood that is used for all joinery work, and as it has the peculiar gift of being able to shrink endways of the grain, and can and does twist and warp in a way to give an American joiner spasms, it is utterly unfit for indoor work except flooring; for weather boarding it answers well, and for rough outside work it forms an admirable timber, as also does the wood of the Puriri; good samples of which form almost indestructible house blocks; for sea piles the Totara is another splendid timber; but for joiner work none of the N.Z. "bush" is at all comparable with the pine timber of the northern world. This is a serious drawback to a country, as all wet-casks have to be imported. Kauri, from its cheapness, is, of course, used; but is a poor and expensive substitute. Another point against these woods is their weight, and panels of doors are made so thin that they give but slight protection. The larva of locusts and other pests destroy immense quantities of timber, as they bore into the trees to such an extent as to make the timber useless for other than firewood purposes. All plantations of fruit trees require careful and costly watching, in order to preserve them from these pests; and the variety and enormous numbers of insect plagues must (coupled with the bird nuisance) prove serious drawbacks to the farmer. I would most seriously warn any intending emigrant against trying to live out of agriculture in the northern districts; the mildness of the climate—of which so much is made—and its excessive humidity—so quietly ignored—form such fine times for both bird and insect life, that their increase is simply astonishing; and the poor sparrow comes in for any amount of objurgation from irate squatters. The mouse and the rat have also found such congenial quarters, that they also swarm all through the bush. In some districts it is the fern that ruins the farmer; in others, the rabbits and wild pigs are his foes, and if the pheasants, &c., increase much more, they also will prove similar curses to struggling cultivators of the soil. Home folks must consider that where so small an area of land is under cultivation, the isolated patches receive the visits of nearly all the inhabitants of the intervening bush when the crop is set, and again when it is ripening. From the *Auckland Star* I extract:—"*The Bird Nuisance.*—A meeting of the committee of the Auckland Agricultural and Pastoral Association was held this afternoon in the office of Mr. Percival (Secretary). The principal business of the meeting was the consideration of the question introduced at a previous meeting by Mr. Lamb, 'How to do away with the Bird Nuisance.' Several samples of grain were shown which had suffered very severely by their depredations—in fact, were rendered quite valueless. A sample of wheat from Mr. Wallis's farm was especially brought under notice." "*The Birds Again.*—Sir,—I should feel obliged if you, or any of the newspapers, or numerous advocates for the formation of orchards and vineries, and planting of fruit trees, would be so kind as to suggest how the fruit is to be protected from the ravages of birds, beasts, and insects, without incurring such an expense as to render it unprofitable. Hares and rabbits attack the bark of the stem and destroy the trees, shell snails and black leeches (which the birds never seem to molest) the leaves and shoots, and various birds consume the fruit. I don't think I have seen a safe cluster of grapes in my orchard since the introduction of birds, nor a safe berry in some of the bunches. Cherries, plums, figs, and other fruits seem to share a similar fate. I had a large and splendid crop of strawberries this year, which had been prepared with great care, but I didn't reap a single berry, the blackbirds and other vermin monopolising the whole as fast as they ripened; and if I attempted to raise grain am obliged to turn it into hay, owing to the sparrows requiring all the seed either when first sown or as the crop matures. The measures lately prepared by some farmers for the destruction of sparrows appear utterly inadequate for the purpose, and little else than a mockery. I recommended them some years ago to combine for their extermination and removal of Government restrictions, when their annihilation would have been more practicable than now. . . . . I perceive by an article in the *Herald* to-day, that an orchard in Nelson, comprising an acre and a half, that used to be very productive, has been completely swept by fruit-eating birds, not leaving a vestige of any kind, from apples to currants.—I am, &c., A Star Reader."—From the foregoing, some of the drawbacks not mentioned in official guides may be inferred; and should I be able to spare time, I will, with the Editor's permission, give other details; but at present I will conclude with one most instructive fact that, well and sufficiently considered, will show the impudence of those who brag and boast about their "Britain of the South." From our "Britain of the North," could a spectator be elevated to a sufficient height to see over half the world, he would view (nearly) the largest amount of land possible; from the Britain of the South he would command a similar extent of water. Now, any reflective person who understands what carriage costs, and how it determines the profit or loss of commercial transactions, will see how splendidly adapted a poor country must be for becoming a commercial centre, when isolated and cut off from all available markets, except at ruinous rates for freight that other and richer competing countries are exempt from.—London Stone.

[51481.]—**Optics (U.Q.)**—"Dubitans" is not required to believe all he reads.—Wm. John Grey, Elswick Science School.

[51495.]—**Polishing Stones, &c.**—Mr. E. Owen will find on p. 147, No. 656, a useful reply to his query, with an illustration of a lapidary's "lap." If, however, your correspondent can obtain Nos. 520, 527, and 535, he will find three letters, in which he ought to be able to read all necessary information to start him on "Lapidary's work."—Essar.

[51501.]—**Cotton Spinning.**—Purchase "The Practical Cotton Spinner," by W. Leigh, price 2s.; or "The Young Man's Assistant to Cotton Spinning," by A. Prestwigh, price 2s. 6d. Both works may be obtained from Mr. John Heywood, Manchester.—J. G.

[51510.]—**Excelsior Lime.**—I do not know this special lime; but good limes can be made out of stone lime. They should be cut with a saw, and be rounded up. See p. 155 last volume.—Essar.

[51520.]—**Granule Carbon Battery.**—Thanks to "Hugh" and "G. H. F." for their kind information. I have tried three cells of the above battery, charged according to instructions given, but sorry to say it is not a constant battery. The first night I tried it it was all that could be desired. The second night a little weaker; and the third night it would scarcely burn the carbon red of a 2½-candle lamp, and was never able to recover itself. I tried it again with fresh liquids, and adding mercury to each porous pot: the result was just the same, excepting the action on the zinc rods was not so great. Would some one kindly say if I have erred in any way, and if you would recommend multiplying the battery power or a small dynamo for lighting a small shop window that is cased all round, such as a shoemaker's window, and where gas would be of no use?—Nill.

[51528.]—**Insomnia.**—This querist cannot do better than read Dr. Edmunds's paper on the subject in No. 920, p. 226.—Essar.

[51530.]—**Fruit Stains on Flannel.**—Has Mr. Hannen read the paragraph on p. 454 last volume? It seems to me he will find something suitable there. —Essar.

[51537.]—**White Metal.**—The alloys used for the purpose mentioned by "Boswell" are rather numerous; but the following is a list which may be useful: 1. Copper, 80; tin, 18; zinc, 2. 2. Copper, 74; tin, 9·5; zinc, 9·5; lead, 7. (The latter frequently used for loco. brasses.) 3. Copper, 82; tin, 16; zinc, 2. 4. Copper, 56; zinc, 28; tin, 16. The latter, it will be seen, is cheaper; but good results have been obtained with copper, 5·5; zinc, 80; tin, 14·5. A white alloy to be cast directly into the boxes is—lead, 32; zinc, 18; antimony, 50. Perhaps the best is—copper, 4; tin, 96; antimony, 8. All the alloys containing copper and zinc are difficult to make. Usually, brass containing a definite quantity of zinc is taken, and added to pure copper previously melted; but the hard metal should always be melted first, and then, as soon as the zinc is ready, be poured into it, the other components added, stirred well, and cast at once. Keep the mixture covered with charcoal dust while mixing.—Nun. Dor.

[51546.]—**Magnets.**—Use a coil of copper wire—stout silk-covered best. Pass a current from a battery through it while at the centre of the bend, and then move it steadily along each limb, taking it well over the ends, but not off. Use a battery giving a powerful current, and pass the coil from end to end several times. A coil of four layers and half a dozen turns is quite large enough. Twist up on a mandrel larger than any bar you wish to magnetise, and tie the helices together with string. —Nun. Dor.

[51553.] — **Hardening Corkscrews.** — If "J. McD." hardens his corkscrews, he must temper them, or they will snap. There is no means of producing temper without the previous hardening.—Essar.

[51619.]—**Specific Gravity.**—I beg to thank "N. C. R." very much for his kind reply to my query. The first part of my question had special relation to solutions of sugar, nitrate of silver, and subcarbonate of soda, and if "N. C. R." can furnish me with a rule by which I can determine from the specific gravity of the solution the amount of any particular substance per gallon, or give me the title of any book treating on the subject, I shall be very grateful to him indeed.—J. R.

[51649.]—**Legal—Intestate.**—If Thos. Goodall has died intestate, leaving a brother or a sister, and children of a deceased brother or sister, then his money would be distributed, half to such surviving brother or sister, and the other half to be equally divided between the children of any deceased brother or sister.—Lex.

[51657.]—**Legal — Settlement.**—A., as the settler, cannot by any means undo this settlement. Such settlement is binding on her, and the trustees must see that the terms of the deed are properly carried out, the property being in trust by marriage for the children, and, in default of issue, for her nephews and nieces. In certain cases, where a mistake is made at the time by either party to which the other party is accessory, although such mistake may have been innocently made, a court of equity may set a settlement aside; but this is not applicable to your case, so A.'s" wish cannot be accomplished.—Lex.

[51659.] — **A Three-Cell Battery.** — Will "Electrician" kindly give me the proportions of ingredients used in the three-cell battery, also whether the ordinary electric-bell wire will answer the purpose, and how would you connect the wires to incandescent lamp? How many lamps will one three-cell battery work?—Norwood.

[51669.] — **Legal—Paving.**—Yes, the urban *authority* have such powers given them by 38 and *39 Vict. c. 55, sects. 149, 150, 153, 156,* and *158.* This last section gives them power by their bylaws to determine and fix a plan the proprietors are to follow, and in default of such notice being observed, the urban authority may do the work themselves, and charge the cost and expenses on the proprietor neglecting to observe such notice.—Lex.

[51682.]—**Legal — Will — Administration.**—No; the husband of the married sister has no claim on his wife's property left after the 1st January, 1883; it is hers solely and separately, and would remain so till she made a gift of it to her husband. Property in Ireland is governed by the Married Women's Property Act of 1882, applicable to England and Ireland, but not to Scotland.—Lex.

[51686.]—**Historical.**—"F.R.A.S." states that "there can be no doubt that Christianity was *introduced* into Britain in the year 597." He should have said *re-introduced*, for there were Christian bishops in Britain several hundred years before St. Augustine landed here. I may refer, as a proof of this, to Gildas, "Britannus Sapiens de Excidio Brit.," p. 23, and to Crakanthorpe "Defensio Eccl. Anglic.," p. 23, from which I give the translation of two short passages: "It is clear that our British Church was founded a few years before that of Rome." Again, "Learn that the Roman Church in Britain was not the mother, but the sister church, and a younger sister by about five years." Gildas states that the British Church was founded towards the close of the reign of Tiberius, who died A.D. 39. The Roman Church was founded in February, A.D. 55, as stated by Baronius. See also Bingham, "Antiquities," ix. 6, p. 20: "Indeed, it would appear that there were more bishops in England and Wales at the time of the Saxon invasion, 150 years before the arrival of Augustine, than there are at this day."—Otter.

[51690.]—**Metaphysics.**—The work I can best recommend is Max Muller's 2-vol. translation of "The Critic of Pure Reason," by the famous German philosopher, Emmanuel Kant. If "T. H." be thoroughly acquainted with the German language it would be well, but not better, to procure the original. Max Muller's excellent translation may be had on loan from Mudie's—Mufti.

[51716.]—**Street Lighting.**—The firms mentioned in your query turn out excellent articles. There are a great many different kinds of lamp-governors in the market, but they may be conveniently reduced to two classes: the older class having leather diaphragms, and the modern class having metallic pistons in place of leather diaphragms. The metallic governors are rapidly displacing the older form; they look much neater in the lanterns, and, from being considerably smaller in diameter, obstruct much less light than their elder brethren. Peebles' people turn out the smallest governor with a leather diaphragm that I know of, and it is furnished with a movable cap so that the weights for adjustment can be altered without taking the top off the instrument. I have tested a great number of them, and I find they are thoroughly reliable. The same firm also manufacture a metallic governor, called the "needle;" this, too, is a very good instrument, and will stand testing pretty roughly when new; but, as far as my experience goes, the metal of which they are constructed is too soft, consequently, after they have been in use a year or so the flange of the conical piston wears beyond the range of adjustment, and they are rendered useless; but this is a defect that could be easily remedied by manufacturing them in brass, instead of soft white metal. Sugg and Co. manufacture a leather diaphragm governor of improved form, in which, instead of adjusting by movable weights, as in the old form, the adjustment is made by a conical-pointed screw, thereby saving a lot of time and trouble in testing. They also make a governor with a metallic piston having grooves turned in its periphery, whereby a small quantity of oil is held by capillary attraction, thus rendering the piston gas-tight without friction. They have also recently introduced a small governor with a steatite bell or piston. This little governor is neat and reliable in its action, and looks well in the lantern; but it has this disadvantage—the bell is rather fragile, and will not bear a fall, and should it require cleaning from dust, I should think twice before I trusted it in the hands of an inexperienced man, such as lamplighters usually are; but if you have experienced fitters at your command to look after lamp fittings, then you could not use a better. Should you not be so happily blessed, then I cannot recommend a better governor than Borrodaile's. This is a neat and reliable little instrument, and will give satisfaction. Its only moving part consists of a brass disc; and you might safely set a man of average intelligence to clean it with a bit of wash-leather without fear of injury. I have submitted this governor to some rather severe tests in range of pressure, and have no fault to find with the results. In fact, after six or seven years' experience of their action on upwards of 2,000 lamps in the district, I find none to suit better, and we are replacing all our old class with them. The size of burner to use depends on the terms of your "lighting contract," and in ordering governors you must state the quantity of gas they must be adjusted to pass per hour. The manufacturer will then furnish the governors with the proper size of burner. If you follow my advice, you will not introduce reflectors in street lanterns. They may look very pretty and effective when new at an exhibition, and work very well on paper; but save me from such abominations as I have seen after being fixed two or three months in the streets. Nothing, in my idea, looks so well as a lantern with a nice light frame, glazed with pot opal on the top, and the bottom with clear glass (the lighting flap glazed with plate to prevent breakage by the torch; all fancy scrollwork cleared away from underneath the lantern, and a light basket frame substituted, just strong enough to support the lantern and no stronger, with the light not more than 10ft. 6in. from the pavement. This style of lighting is far before fancy reflectors: the white top, whilst throwing the greater part of the light on the pavement, allows sufficient light to pass through to give the lantern a cheerful appearance. —J. R. Warren.

[51735.]— **Boat.** — Cross your plan with ½in. squares; if you object to the pencilling over it, then you can divide it by fine threads; then rule a large sheet of paper to the particular scale for the enlargement, and carefully trace the contents of each small square into the corresponding larger one. If you desire to be desperately exact, you may use ¼in. or ⅛in. in the first instance. This must give a correct copy.—H. O'B.

[51748.] — **Water Rates — The "Dobbs" Case.**—The Grand Junction Act, 7 Geo. IV. c. 95, enacts that water rates be charged on "rent where the same can be ascertained," and where not, then on "the actual amount or 'annual value' upon which the assessment to the poor rate is computed." A later Act says simply, "annual value." Question 1: Is the old Act repealed? and if not, as Mr. Dobbs lives in his own house and pays no rent, what is his "annual value"? Question 2: If it is repealed what is "annual value" in the later Act? Decisions—Queen's Bench: Old Act is not repealed, and where no rent, "annual value" therein is the rateable assessment to the poor rate. There "annual value" *per se*, as referred to in the later Act, was not argued before the Court. Court of Appeal held also that the old Act was not wholly repealed, but decided it to mean rent if any, and where none, the equivalent of rent which is the annual or gross value from which the poor assessment or rateable value is computed, as otherwise the anomaly would arise that owners would pay water rates on a lesser basis than tenants. The Court further said that though "annual value," *per se*, had not been fully argued before them, they were of opinion that it would make no difference: they considered it the same thing as the rent in the old Act, or what is now called "gross value." House of Lords: That the decision of the Court of Appeal should be reversed, and that of the Queen's Bench restored, for reasons to be given at the next sitting. Mr. Dobbs, in a letter to the papers dated 18th August, 1882, said, "If the judgment of the Court of Queen's Bench is confirmed, my case is over on the narrow issue; but if the higher courts reverse the judgment, *then* we fight on the broader issue—viz., the meaning of 'annual value,' and every ratepayer will watch that, if it comes on, for though it will only bind the Grand Junction, it will forecast the result in other cases." The highest court deciding the first issue in Mr. Dobbs's favour, the question of annual value has not been fought out at all on this occasion: the effect is simply that owners living in their own houses in the Grand Junction district, are to pay on about one-fifth less value than tenants who are not owners—the very anomaly referred to by the Court of Appeal; but those vestries and ratepayers who have subscribed to Mr. Dobbs's fund under the delusion that his was a "general" case, have no right to blame him, as the above extract proves. It may be mentioned that two of the House of Lords judges, Bramwell and Blackburn, were parties to a decision in the well-known Sheffield case wherein it was decided that "annual value" meant the rent payable on an ordinary yearly tenancy, tenant paying tenants' rates, and landlord paying landlord's rates. There have been other decisions on this "annual value," in connection with the house duty and property tax, licensing acts, voting qualifications, and other questions, in all of which it bears one and the same meaning. See also the schedule in the Metropolis Valuation Act, 1869, where the forms to be filled up expressly define it as the rental or gross value, and the rateable value for poor-rate purposes as something to be calculated from it.—Q.

[51755.]—**Legal—Medical Electrician.**—If the testimonials have been addressed to B. only, they would no doubt be his property; but in that event I should make use of the local newspapers to explain same away, or go round to the persons giving the testimonials and get fresh ones addressed to A. only. If the testimonials are already addressed to

A. only, then they are A.'s property, and can be demanded, and on refusal obtained by action of detenue; but if addressed to A. and B. jointly, then explain them away in local newspapers, as in my first suggestion, and, if necessary, get an injunction and damages from one of the courts.—Lex.

[51756.]—**Cartridges for Martini-Henry.**—The powder used for this rifle is known as R.F.G.² (rifle fine grain) the (2) denoting a superior quality. It is manufactured at Waltham Abbey. The amount is 85grs. I can't understand how it is you found no wad in the Government cartridge, as there is a cardboard disc on the powder, then a wad of beeswax and then two more cardboard discs. The bullet is secured in the cartridge by the top of the case being choked into two cannilunes round the lower part of the bullet. The case is not solid drawn, but consists of two turns and an overlap of ·5in. of ·004 brass. The cartridge is a little off 3in. in length. The bullet consists of 12 parts of lead and 1 of tin, and weighs 480grs.—Artilleryman.

[51760.]—**Shoe Repairing.**—Good sewing must be learned by practice alone. Well wax eight cords of No. 12 white for ordinary men's, nine, even ten, if very stout soles, five or six for women's; then hang on a hook, pull all the stretch out, rub up and down once or twice, and it should resemble gut. Use awl so that the thread can only easily pass stitch behind, if possible, as sewing is not discerned. Strength does not depend on a thick thread; but cut channels as deep as possible, use wax every half-dozen stitches, pull all well together while moist with plenty of work, and, by all means, soak and well hammer your leather before sewing, if you wish it to wear.—A Mechanical Snobbie.

[51767.]—**Continuous Brakes.**—To "Historian."—From the description given by your correspondent, there can be no doubt that the train he saw at King's Cross, Metropolitan, was one belonging to the Metropolitan District Company, and, therefore (like all its rolling stock), fitted with the Westinghouse air-pressure brake. The brake has been in daily use on this railway since 14th February, 1873, upon which day the first trial trip was made on the line. From the notes I took at the time, I find the experimental train consisted of engine No. 18 and eight carriages, and it ran from the Mansion House to West Brompton. The carriages had previously had Clark's chain brake; but this was taken off, the brake blocks and some parts of the gear being, however, utilised. The Westinghouse air-pressure brake only requires *one* line of pipe throughout the train; but in this country two pipes and the check valves have always been employed, in order to prevent the possibility of failure. The statement of the official "that they have two sets of pipes, and that if one fails the other works," is perfectly correct. The two lines of pipe extending under the train connect to the brake cylinders and with each other, through a simple check-valve, so constructed that in the event of any damage to one pipe, it instantly and automatically cuts off communication between the two lines, leaving the unbroken pipe in perfect working order. The couplings are provided with valves, which are open when coupled, and closed when uncoupled. Therefore, if a train breaks loose, the driver has control of the brake on the front portion (and in cases where the vans are fitted with reservoirs the guards have control). This air-pressure brake was a great improvement upon previous systems, but it has the defect of being non-automatic. For further details of the brake I refer "Historian" to Vol. XV. p. 295, 1872.—Clement E. Stretton.

[51779.]—**Metallic Precipitates.**—I am afraid I have not explained clearly enough what I wanted. I would like to know the best way for precipitating separately:—Bronze as a metallic powder, copper as a metallic powder, and zinc as a metallic powder. —An Experimenter.

[51779.]—**Metallic Precipitate.**—What does "An Experimenter" really wish to do? Does he require to separate the constituents of the bronze by way of analysis, or to obtain each constituent in the form of metal for commercial purposes? The copper can be easily precipitated from an acid solution by means of scrap iron.—No Sig.

[51782.]—**To Violinists.**—"Amateur" should get a little work entitled "How to Hold a Violin and Bow," published by Pitman, which contains very good descriptions of the various bowings collected from standard works on the subject. Of course, however, "Amateur" is aware that a few lessons from a really good master would teach him more than any amount of reading. With regard to the bow, my opinion is that a good one can be bought for 20s. or 25s., and that the lower-priced bows must necessarily be inferior, as they are turned out in large quantities by the makers, who cannot take time to select the sticks. In this principally lies the difference between cheap and dear bows, as for the latter only the finest selected sticks are used. Some few makers, such as Tubbs, make beautiful bows, which are not dear at £3 or £4; but a guinea bow is quite good enough for all ordinary purposes. I do not think there is much art in rosining. Get good rosin, hold it in the left hand, and the bow in the usual position for playing, giving it three or four strokes on the rosin evenly from end to end, so as not to have more in one place than another.—War.

[51788.]—**Compound Engine.**—Seeing that "Engineer, Dewsbury," has not corrected an error in his answer to the above query, I take the liberty of doing so. The steam by gauge of 125lb. will, in reality, be 140lb. from pure vacuum line, or 15lb. below atmosphere, from which all calculations upon expansions must be reckoned, whether for condensing or non-condensing. Supposing there is no loss between the engine and the boiler, the steam will enter the high-pressure cylinder at 140lb. gross, and cut-off at one-third of the stroke. The final gross pressure will be 46·66lb. This steam has now to enter the low-pressure cylinder, whose volume is three times that of the high-pressure one, and whose cut-off is one-third of the stroke. Hence, to fill this space the steam must expand into one-third more of its volume, and thus become one-third of its pressure, 46·66 − 15·55 = 31·1lb. gross. This is the back pressure in the high-pressure cylinder, and not 41·66lb., as stated by "Engineer, Dewsbury." The back pressure in high-pressure cylinder will be 31·1 − 15 = 16·1lb. above atmosphere. The initial effective pressure will be 125 − 16·1 = 108·9lb. The final or terminable effective pressure will be 46·66 − 31·1lb. = 15·55lb. Next, the 31·1lb. of steam in the low-pressure cylinder is now cut-off at one-third of the stroke also, and expands through the other two-thirds of the stroke, and thus becomes two-thirds of its pressure, 31·1 − 20·73 = 10·36lb.; so if we allow 3lb. for back pressure in condenser, as stated, the initial effective pressure will be 31·1 − 3 = 28·1lb. The final or terminable effective pressure will be 10·36 − 3 = 7·36lb; so if we divide the initial effective pressure by the final effective pressure, we shall get the number of expansions in each cylinder. Now for the high-pressure one, 108·9 ÷ 15·55 = 7 expansions. The hyperbolic log. of 7 expansions, 1·946 plus 1 = 2·946, then 15·55 × 2·946 = 45·82lb. average pressure throughout the stroke. The horse-power will be 50·26 area of cylinder × 45·82 × 300 ÷ 33,000 = 20·9. Then 28·1 ÷ 7·36 = 3·8 expansions for low-pressure cylinder. The hyperbolic log. of 3·8 expansions is 1·335 plus 1 = 2·335. Then 7·36 × 2·335 = 17·2 average pressure throughout the stroke. The horse-power will be 153·93 area of cylinder × 17·2 × 300 ÷ 33,000 = 24.—Fiber, Dewsbury.

[51792.]—**Cancer.**—I had a great aunt who was a famous doctress 40 years ago. She recommended, beneficially, to my knowledge, best Turkey figs boiled in new milk, three or four to a pint, to be used in the diet, one or two figs every day, and also as a poultice on the sore or swelling. I would say try it: it is simple and harmless.—H. O'B.

[51792.]—**Cancer in the Mouth.**—I beg to inform "Nun. Dor." that he does not hold a correct opinion on cancer of the mouth. It is now a well-known fact—amongst surgeons—that this cancerous condition is produced by the irritation of the pipe. The reasons why we think so are—first, because it is nearly always seen on the lower lip only. Second, it is very rarely seen alone on the upper lip. Thirdly, it is very uncommon in women and amongst non-smokers. If "Nun. Dor." will consult any medical man who is fairly up in his work, he will get the same opinion as I have stated. —T. R. Allinson, L.R.C.P.

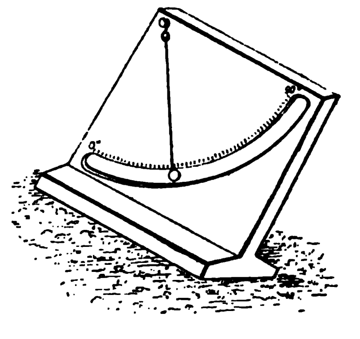
[51792.]—**Cancer in the Mouth.**—I regret that absence on the Continent prevented my seeing this query before. I have seen two cases of incipient cancer in the tongue within the last year, both of which have been cured under treatment of a non-surgical character. The doctor consulted was the famous Mr. Banks, of Liverpool, whose address would be found in a directory of that city. After some preliminary treatment, with a view to purifying and enriching the blood, both cases were sent by him to the baths of Aix-la-Chapelle, in Germany, on the borders of Belgium, not a great distance hence, nor an expensive journey to undertake.—D. de B.

[51804.]—**Reducing Thickness of Wire.**—I have tried rollers and failed, as it laps the steel wire. We use a small lathe, and it turns out some hundreds of gross per day. It requires a good mechanic to make the lathes. If "Eccentric" will advertise his address, I will advise him where he can get wires reduced in any shape he requires. —Perseverance.

[51806.]—**12in. Cylinder.**—I suppose "J. G." means that there is a space or "clearance," as it is generally called, of ⅛in. when the piston is at the end of the stroke, when he speaks of a "vacuum of ⅛in." Of course he will save steam, and lose no power at all, by filling in this most unnecessary space as he very properly proposes.—A. A. Myall.

[51806.]—**12in. Cylinder.**—In reply to "J. G." respecting the above, he had better either have two new cylinder covers ⅜in. thicker than those he has at present, or put a ¾ plate on each cover, taking care not to stop up any part of the ports giving free admission to the steam. As it remains at present, he is wasting his steam, which would amount to a considerable quantity in a day if the engine is worked many hours. ⅛in. is quite enough clearance. Shall be glad to give him any other information he requires.—Physis.

[51800.]—**Measuring Hills.**—The instrument required is a "clinometer," a simple form of which is sketched. It is constructed of wood 2¼in. square by ¼in. thick. The scale reads from 0° to 90°. The angle of inclination of the hill with the horizontal is the angle which is cut by the line of the plumb-bob.—Gassan.



[51808.]—**Legal—Bill of Sale.**—You would not be liable to any action for selling, unless you previously had notice of such bill of sale. The grantor is now liable to pay the grantee's balance debt.—Lex.

[51808.]—**Legal Replies.**—Take no notice of the loan society. They have no power to touch you, so long as you handed the cash of the goods sold to the customer, and the remainder of the goods to the society when demanded. Let them punish the customer. It might probably be different did you know at the time there was a bill of sale.—R. R. R.

[51809.]—**Cloudy Object-Glass.**—Soak them in spirit of turpentine for a few hours, then rub them gently with clean cotton wool soaked in the spirit, and finish off with clean wool and spirit. If the glasses are still stained, rub them with wool and strong nitric acid (this is highly corrosive), wash in clean water, and dry in a clean cloth. Take particular care to put the proper surfaces of the object-glass together, and if you want to re-cement them, put in the concave glass a small quantity of good, clear, clean Canada balsam, which you must obtain from a chemist. Warm the glasses gradually till you can scarcely bear them in the hand, and if the balsam contains any air bubbles, these must be pricked out with a fine needle, then lower the convex glass into the concave, taking care not to form or inclose any air bubbles. While the glasses are still warm press gently with a finger on the top of the convex glass in the middle, and move the glass a little bit to and fro; this will work out the greater part of the balsam, leaving a very thin film between. When the glasses are cold, this film will be hard enough to keep the glasses fixed closely together. Object-glasses larger than 3in. in diameter are not generally cemented.—J. C. L.

[51824.]—**Diaphorite** is thus described in Dana's "Manual of Mineralogy." Diaphorite = trimetric freieslebenite, and freieslebenite is described as a monoclinic antimonial silver and lead sulphide of a light steel grey colour, with specific gravity 6—6·4. It contains 22 to 24 per cent. of silver, and is found in Saxony, Transylvania, and Spain.—W. Farquhar.

[51825.]—**Testing Value of Watch.**—Your only way is to take it to a respectable jeweller or pawnbroker. No one through the pages of the "E. M." could give you information sufficient to enable you to safely estimate the value of your watch even approximately. The hall marks are stamped in when the cases are in the rough, at certain towns fixed by Act of Parliament. There are so many different marks relating to date of stamping, place of stamping, standard of metal, and manufacture of the article, that pages of the "E. M." would be required to describe and explain them. But if "Horo's" watch has English marked cases and is of 18 carat gold, it will have for one of the marks a crown, and if stamped in Birmingham another mark will be an anchor, and if "Horo," or any other reader of the "E. M." takes sufficient interest in the subject, he will find it treated exhaustively in the "Book of Hall Marks," price about 2s. 6d.—Hall Mark.

[51826.]—**Vacuum Brake on the L. and N. W. Railway.**—To "Vulcan."—The following trains on the London and North-West

QUERIES.

[51936.]—**Crystal v. Paraffin Oils.**—Would some reader oblige by giving a simple way of distinguishing between paraffin and crystal oil (Royal daylight)?—Chandler.

[51937.]—**Time Signals—Chemical Heaters.**—Will some obliging correspondent kindly favour me, in "ours," with a simple figure illustrating the most practical method of dropping a time ball by means of electricity? Please do not refer me to back numbers, as that is out of the question. Also will any one kindly inform me what carbon natron is? I learn from a German that it is used as fuel in a patent stove lately invented in Germany. Also that heaters are made, using acetate and hyposulphate of soda. Could anyone give me full particulars of these latter, and if they would be efficient in heating a room where the therm. seldom falls below the freezing point? Also the commercial value of the soda?—Ex. Nauticus.

[51938.]—**Musical.**—Would anyone kindly tell me why modern professors of music differ with the interval of a fifth—viz., C to G flat, some calling it a minor fifth and others positively declaring it to be a diminished fifth? And why Dr. Stainer, in his book on Harmony (when treating of the intervals), states in a table, p. 14, that a fourth is consonant, and also that a fourth (when not an inverted fifth) is dissonant?—Beethoven.

[51939.]—**Renovating Silk Mantle.**—A lady has a black corded silk mantle. The under side of sleeves and the front part is shiny, and has the appearance of being greasy. Can anyone inform me what will remove the shiny parts alluded to?—Preston.

[51940.]—**Waterwheel.**—Will any of our readers kindly state the method to find the nominal h.p. of a waterwheel 16ft. high, 4ft. abreast, with a 9in. ring working an 8in. plunger-pole 6ft. stroke, at the rate of ten strokes per minute, with a full supply of water?—Poor Labourer.

[51941.]—**Compound Locos, L.N.W.**—Is the gearing adopted for the high-pressure cylinders on the above engines Mr. Joy's patent? I see there is some difference between this and the low-pressure gear, though it may only be due to the position of the cylinders.—W. Thompson.

[51942.]—**Music-Halls.**—Can any of your readers enlighten me on the law of music-halls in reference to the following?—Can two persons (male) play a dramatic sketch in two acts? I have been told that they can safely, but that three persons cannot. Full information will oblige.—Dramaticus.

[51943.]—**Income-tax.**—A friendly society has surplus funds invested, and receives the interest at the bank half-yearly. A deduction is, however, always made for Income-tax. Ought the society to pay the tax? If not, can the amount be reobtained?—J. U. H.

[51944.]—**Coppered Wire.**—Can some of our readers tell me how common iron wire is made to look like copper? Also if it can be applied to hardened steel goods? What I want is some cheap and simple process without heat?—W. Henry.

[51945.]—**Boiler.**—Will any of ours say which of the two boilers is the strongest, both 30 by 7ft., and made of the same material: but the shell of one boiler has eleven plates, the other has only eight; both double-riveted in the longitudinal seams?—C. T.

[51946.]—**Rowlocks.**—I should feel obliged by information with respect to an arrangement of rowlocks which automatically "feathers" the oars, and another arrangement by which a person can pull with his face forward—as he sits when paddling. I believe both methods have been successfully tried.—O.

[51947.]—**Link-Motion.**—Will some one kindly give me a short description of Allan's "straight link" motion? Also a reversing gear without any slot-link at all.—Physis.

[51948.]—**Brakes.**—Perhaps some reader could inform me as to what brake is used on most of the G.W.R. locomotives running in the Bristol and South Wales district? Also a description, with small diagram, of Sergeant and Bolitho's automatic vacuum brake, used on the Midland Ry.—Physis.

[51949.]—**Zoophyte Trough.**—Having occasion to keep some pond water in a zoophyte trough, I found after a day or two that the trough had come to pieces—I suppose on account of the action of the water on the cement with which it was put together. Will any of our microscopical friends kindly give me instructions how to cement it together again?—Cymro.

[51950.]—**Loss of Smell.**—I should feel very thankful if any one can inform me in my case how to regain the power of smelling, having lost it for a very long time? I am 21 years of age, and a gasfitter, and the loss tends very much to my disadvantage, as I cannot smell the escapes.—E. H.

[51951.]—**Astronomical.**—It is stated in this week's "E. M." that the displacement of the planet Mars by the attraction of the earth amounts in two centuries to five minutes of arc, or about 200,000 miles. Wanted to know what the displacement of the earth, if any, by the attraction of the planet Mars amounts to during the same period?—J. M.

[51952.]—**Stage Micrometer.**—Can any one inform me how to make a stage micrometer, either by photography or otherwise? I have drawn very carefully on paper the divisions, &c., as I wish them to be in the micrometer, and have then arranged things, so as to get a photograph of exactly the requisite size; but, unfortunately, the deposit of which the image is made up is too coarse for the thing to be of any use,—too coarse even with a 1in. objective. I have tried various developers—iron, pyro, and gallic acid—and various strengths, but although the results are not all alike coarse, none are good enough for the purpose. I ought to have said that I have only used the collodion process. Albumen seems too troublesome, and vastly more liable to be spoilt by dust. I shall be very glad of any help, for I look upon it that one who can handle his microscope well, is a pretty good photographer, and not bad at mathematical optics, ought certainly to be able to make his own micrometer.—E. M. S.

[51953.]—**Electro-Motor.**—Would Mr. Lancaster kindly say if 22oz. of No. 16 cotton-covered wire was good proportions for field-magnets of small motor (Siemens' H armature), 3in. long by 2in. diam., and 6oz. 16 c.-covered for armature? Also what power it should give, it being mechanically well fitted together, and how many bichromate batteries it would require, say, zinc exposed surface 4in. by 3in.?—W. H. M.

[51954.]—**Cement for Fastening Indiarubber Slips in Steam Vessel Side-Lights.**—Could any readers inform me what is the name of the composition or cement used to fasten indiarubber strips into side-lights of steam vessels? It must be able to stand the action of sea water.—W.

[51955.]—**Electrical.**—Can any reader give me the approximate resistance of any of the Atlantic cables and their electrostatic capacity? How can I arrange an artificial submarine cable on the Varley system? How are the condenser plates arranged?—F. C.

[51956.]—**Incandescent Lighting.**—When a number of incandescence lamps are turned off, why should the remaining lamps increase in brightness if a separately excited dynamo is used? Theoretically for incandescent lighting a constant speed is required to maintain a constant E. M. F. Now this being done, say half the lamps are turned off, the resistance is doubled and the E. M. F. remaining the same the current is halved, which should leave the remaining lamps just their correct amount of current and no more, yet practically they always get more current when a number are turned off; the slight resistance of the armature is hardly sufficient to account for this variation. Will "Sigma" or others kindly explain?—F. C.

[51957.]—**Weak Magnets.**—To "Sigma" or Mr. Lancaster.—I have a Clarke's magnetic electrical machine which appears to be in good order, but which only gives a feeble current. The permanent magnets are of the horseshoe shape, and are five in number, screwed together; they weigh 14lb., but will only lift a piece of iron weighing 2½lb. Is not this small power in the magnets the reason for its not acting more satisfactorily?—and if so, please oblige by informing me how I can best remagnetise them? This query comes from the Antipodes, and I wish if possible to strengthen them here, and so save the time and expense of sending them to England.—Subscriber.

[51958.]—**Electro-Plating Query.**—Would some of the readers of "ours" who have practical experience in electro-plating by the cyanide silver process, kindly point out the cause and remedies for the following difficulty? Upon starting the battery everything goes on all right for a time; but the anode, instead of remaining clean, becomes discoloured and covered with a black deposit, and the plating ceases, or goes on very slowly. Does the cause of this rest with the solution or with the battery? An answer, with practical suggestions for keeping the anode bright and clean, will much oblige—An Amateur.

[51959.]—**Wasps' and Bees' Stings.**—Can anyone tell me the name and nature of the poison of the wasps' and bees' sting, and, also, how does a flea raise such a fearful blister?—F. G. A.

[51960.]—**Oxy-Hydrogen Microscope.**—To Mr. Lancaster.—I have lately purchased an oxy-hydrogen microscope, which has apparently been unused for some years, and is not quite perfect. To save the trouble of engraving diagrams, I may mention that the apparatus is exactly represented in "Pepper's Play Book of Science," p. 123, with the exception of Gurney's set, which I have not. The burner, which is made for using mixed gases, is composed of three parts; the lower part is screwed to the stand, the middle part is a tube of some 6in. in length, and has a tap at the bottom to connect it with the gasbag. This part of the tube appears to be packed with fine wires lengthways; the top part contains the jet and pin for lime cylinder, but at the lower part of it, and where it is screwed into the longer tube, there is a screen of fine wire gauze. Is this jet safe with ordinary care?—and how are the gases mixed in the bag, so as to have the proper quantities of each? The microscope consists of a large tube screwing into the camera, in the usual way, and it contains two lenses (condensers) 2½ diameter, and separated by a sliding part which can be regulated so as to move the lenses nearer or apart about 3in.; on the end of this larger tube, another tube slides, containing a stout spiral spring, and an aperture to hold the object to be magnified; attached to this is another tube, moved by a rack and pinion, and which I think should contain the object lens, but the lens is missing. There is another lens, however, attached to a loose brass plate, which slips in the end of the tube containing the aperture for the object. Will you kindly inform me what other lens is required, and the use of, the movable lens I have just mentioned? Can I use the condensers as a magic-lantern by adding the additional part to hold the slides and a tube for the object-glass? Any information will oblige an old subscriber to "ours."—Tasman.

[51961.]—**Cleaning Object-Glasses.**—Perhaps Mr. Lancaster, or "Prismatique" will kindly give me some advice in the matter of cleaning telescope object-glasses? I frequently find, after using my telescope at night out of doors, that the object-glass becomes speckled with something that is not exactly dust (notwithstand- the use of a dew cap) and which smears on being brushed when dry. To allow it to remain for long, not only means a loss of light, but surely must also do damage to the polish of the glass. Now mere brushing, as I said before, will not remove it, friction of some sort, with breathing, being necessary. And yet we are told by some ("F.R.A.S." in particular) to avoid wiping the glass. Of the two evils, which is the lesser? For my part, I cannot resist the temptation of removing it, and for that purpose I use a tuft of pure cotton-wool with gentle rubbing. Now is this likely to do harm if applied, say once a week? Also, is it advisable to wipe between the lenses, say once a year?—(What would "F.R.A.S." say to this, I wonder!) Some practical advice in these matters would, no doubt, be much appreciated by all who use astronomical telescopes in the open, and particularly so by—Achromatic.

[51962.]—**Water Company's Charge**
Mr. Wetherfield answer the following?—
beginning of the present year the New Riv
have served notices to the tenants of several
North of London, taking a few roads each
suppose to prevent combination, to pay an ext
water rate, and they quote the 70th cla
"Water Company's Act" as their authority
claim. I had paid the rate up to the 24th
because I had not paid another quarter in ad
cut the water off, and before I could have it
had to pay all expenses as well as a quarter
It appears to me that the quarter in advance
paid, as the 70th Clause reads:—"And the fi
shall be made at the time when the pipe
communicate with the pipes of the undertake
time when the agreement to take water from
takers is made." That would be at the tim
house was made habitable I should lik
whether the company were acting legally whe
the water off, or if I can sue the company for
O.

[51963.]—**Electrical.**—I desire to make a
(½-pint cup) carbon zinc battery, one cell, co
powerful enough to deflagrate platinum wi
used at night, the zinc or zincs might be slidi
batteries. Will some brother amateur say
or liquids are best, and how and on what met
should be fastened?—R. Hannen.

[51964.]—**Electric Battery.**—I have a
zinc battery. If I were to use chloride of
and muriatic acid instead of ch. of zinc, would
be prolonged? I use 1½oz. per cell of ch. of
much ch. of am. and muriatic acid should I
duce the same intensity, my object being on
longation of the battery power?—R. Hannen.

[51965.]—**Rash.**—To "The Kent Her
you advise in the following case?—A young la
of age has from childhood (it came on just aft
tion) been subject to a rash which makes its
at the fall of each year, and after a while
open cracks just at the bend of the arm. Thi
throughout the winter, causing great pain a
No skin disease has been known in the family
though there are many other children. Seve
men have been consulted, but without any last
—J. E. H.

[51966.]—**Making Small Drills.**—W
best way to make drills to fit small screwplate
which are 1-16in. upwards?—W. G. F.

[51967.]—**Seasoning Boxwood.**—I ha
cwt. of green boxwood cut last month, a larg
which is about 4in. thick. What is the
season and prevent from cracking?—W. G. F.

[51968.]—**Handbell Tuning.**—Can a
readers tell me the best way to tune handl
have a three octave (chromatic) peal, from C
size, and some of the lower bells are far too shar
those in the keys of E flat and B flat. I have he
of tuning, by slipping iron rings over the shou
bells, but do not know at what distance the
be from the crown of the bell. There is
metal left in the crown for further turning o
an inside layer of solder near the crown
flatten, without weakening, the tone?—C. W.

[51969.]—**L.C.D.R. Engines.**—Wanted
of the new bogie tanks Nos. 75 and 76, by Ste
McK.

[51970.]—**Secondary Batteries.**—T
Siemens.—At p. 104 of the "E. M." for Oct.
that you have used secondary batteries with
nearly a year. It would be very interesting,
to others besides myself, if you can kindly
particulars respecting them. For instance,
cells, and of what size, are required for the
cent lamps? How long does it take to charge
the dynamo, and what make of dynamo is
Are these cells home-made, or are they those
(at such high prices) of the Faure-Sellon-Volc
What materials are necessary for cha
how often must they be renewed? La
the waste products of the batteries
or commercial value? I have water-po
easy reach, and am hoping some day to u
electric lighting; but one can hardly leave
(making several hundred revolutions a minut
itself, nor can one expect a man to sit up with
night or longer, unless he is retained for
only. It was stated two or three years ago
Armstrong lighted some rooms in this man
accumulators were mentiond; so an attenda
bably within reach of the machinery all the
Antares.

[51971.]—**Air Condenser.**—Could any
instruct me to the way to make an air co
testing?—Edwin Jun.

[51972.]—**Valuation.**—I shall be oblig
your readers will oblige me by an answer
purchase a lease of some land and premises,
which has 19 years to run from Jan. 1, 18
£100 a year. What sum should I pay down
have named, as value or compensation to t
the lease? Money worth, say, 5 per cent.—J

[51973.]—**Velocity of Steam.**—I
glad if "Glatton," or any other reader, cou
rule for finding the velocity (in feet) of s
given pressure issuing from a tap on a boile
Blackburn.

[51974.]—**Engine.**—To "Glatton."—M
¾in. outside lap and a ⅛in. lead on main va
haust is without lap, and has a ⅛in. slip;
the valve is 4in., and that of the piston 40
point of the stroke does the exhaust close?
this by rule, so as to enable me to comp
Thomas Blackburn.

[51975.]—**Resistance.**—Will any rea
Kirchhoff's bridge, and how it is used to me
ances, or say where a description may be fo
S. H.

[51976.]—**Piano Wrest Plank.**—An
piano has a crack running through all the w

It is in a village far from any piano repairer. One tuner suggests an iron plate, and another the insertion of a new piece of wood. Which is preferable? Could an intelligent village joiner be trusted with the work? Hints how to proceed and what to avoid will be thankfully received by—M. C. S.

[51977.]—**Ejector.**—I have taken in hand the repair of a steam launch, and amongst the list of things I got from owner to be overhauled is a small ejector, used for ejecting bilge water, which has never given satisfaction in its water-ejecting powers. I had a trial with it myself, and find it lifts water after having a little patience with it; but it will not continue working (I mean ejecting water) more than half a minute or so. It lets slip the water, and then we have to commence anew with it, which is a great nuisance, as steam launch is used greatly by a lady and gentleman, with family, having always steam from ejector flying amongst them. It is not quite exactly the thing for a steam launch that is mostly used for pleasure. They are in general got up with everything about them neat, clean, and all in good working order, which my endeavours will be to put out in the same style as above mentioned. I put a new cone into inside of ejector, having found it was bored or turned all to one side, also cut suction pipe and placed ejector 10in. above level of water; but with just the same result as before. Will some practical reader of "ours"—for example, "Glatton," S. Austel, or "London River"—kindly give their opinion so as to assist me out of my difficulty?—Hombre.

[51978.]—**Hyposulphate of Soda.**—Would any of your readers kindly say if the above can be cheaply made from ordinary washing soda or any other compound of soda? I am going to the colonies in a week or two, and am afraid I shall have a trouble to get the hypo.—Hypo.

[51979.]—**G.W.R.**—Can any reader oblige me with the size of driving-wheels, &c., (1) of the Nod. B. G. singles; (2) of engine No. 152, 4 c., N. G., which appears larger than other N.G. engines?—T. M. R.

[51980.]—**Cattle Spice.**—Would one of "ours" insert a recipe for making a cheap condiment or cattle spice suitable for flavouring some chop cut from hay of moderate quality? I should like to know the quantity of each ingredient used.—Condiment.

[51981.]—**Electric Testing.**—In connecting the terminals of a galvanometer to a 4½in. bell as fixed in going order, a slight (5 degrees) deflection is seen. If I remove either one of the bell's wires and again insert galvanometer as before, the needle is deflected as far as possible. I can find no leaks, connections of wires or anything wrong, the pushes are all good. This wasting current is insufficient to ring a very small bell, though the hammer perceptibly moves when such bell is inserted in place of the galvanometer. How can I find the fault?—where is the probable defect? There are five bells, two semaphores, a needle instrument, a relay, and an annunciator, all on the battery—a four-cell chloride of zinc. Help is solicited.—R. Hannen.

[51982.]—**Electro-Magnetic Machine.**—I have a small electro-magnet of soft iron, horse-shoe form, core ¾in., poles 1in. apart, capable of lifting 25lb., which I want to take part in an electro-magnetic machine. Will Mr. Lancaster or any correspondent tell me size of armature, weight and gauge of wire for each bobbin, to get good result, even to producing a small electric light? A. C.

[51983.]—**To Mr. W. J. Grey.**—Will Mr. Grey be kind enough to recommend books for machine construction and practical geometry, Honours stage?—I have passed in Advance. Does he know of any published information concerning the Whitworth scholarships, other than the prospectus of the Science and Art Department? Answer to the above will greatly oblige.—A. P. G.

[51984.]—**Dissolving Guttapercha.**—Can anyone inform me the exact strength of spirits required to dissolve guttapercha or indiarubber?—H. F.

[51985.]—**German-Silver Leads.**—Can any of our scientific readers help me out of this difficulty? I want to know what diameter and length of German silver wire is required to equal 1 ohm resistance, and to carry 100 ampères of current, without heating. Any information on the subject will oblige.—H. F.

[51986.]—**Electric Currents in Dynamos.**—Will "Sigma" kindly explain why the polarity of the field-magnets in the alternate dynamo is not reversed by the current from the armature? I hoped to be in possession of his second edition of "Electricity" before this. How soon may we expect it?—Field-Magnet.

[51987.]—**Hunnings Telephone.**—Would some one be good enough to describe the receivers and transmitters of the above telephone system? If formerly described, my back numbers do not go back sufficiently far.—Micro.

[51988.]—**Tapering Corks.**—I shall be glad if anyone can give me particulars of a machine for this purpose, and if attachable to a lathe so much the better.—C. W. F.

[51989.]—**Burnisher.**—I have been making a burnisher, the burnishing surface being of soft steel, while the roller above is of brass. I find, however, that the steel plate invariably scratches the card which is being burnished. Recently I got the plate hardened and polished, but with no better result. Would substituting a steel roller in place of the brass be an improvement?—If not, what is the cause and what the remedy?—J. A. Hislop.

[51990.]—**Carriage Lift.**—I am desirous of raising and lowering carriages from one yard to another, the height of the top yard from the lower one being 13ft. Can any reader advise me how to do this effectively and as cheap as possible?—Tynedale.

[51991.]—**Star Magnitudes.**—Will any correspondent kindly oblige me with the following particulars? (1) The exact magnitudes of these stars (all of which are classed as 3rd. mag. in Proctor's small Atlas):—α Andromedæ, α Coronæ Borealis, α Ophiuchi, α Capricorni, γ and λ Ursæ Majoris. (2) The name of any good French periodical partially or wholly astronomical, with its published price. (3) The position and mag. of the star 1830 Groombridge.—Stella.

[51992.]—**Metallo-Chromy.**—Can any of ours give me information on the above? I tried soaking white blotting paper in sugar of lead and put a strip of tinfoil on each edge to battery, but get no results. What battery power, and would a coil help?—G. Reed.

[51993.]—**Engine Query.**—Would any one of ours help me out of a difficulty? We have a condensing engine working at 60lb. pressure and 140 revolutions per minute. There is a loud thumping noise at the crank bearings when the piston is at each end of the stroke; if the brasses are tightened so as to minimise the thumping, they heat. What is the cause of the thumping?—is it defective cushioning?—and how may it be remedied?—C. Guillaume.

[51994.]—**The Heliostat.**—I am reading with great interest your account in the "E. M.," of the "theory and construction of the Heliostat." For the last twelve months I have been working with a 9in. reflector; but, like a good many other workers of that form of instrument, I am increasing my size of aperture. Suppose with my new instrument I did away with the stand, and put the mirror and tube in a fixed and horizontal position, could I use a heliostat?—and if so, what form, to throw the rays of a planet or star on to the mirror and keep it there? I have read that it is used in America; but beyond that I have never been able to meet anyone who could enlighten me on the subject.—M. T.

[51995.]—**Extracting Dust and Lime from Wool.**—Can any reader give me a description of a hand power machine suitable for use by a fellmonger to extract the dust and lime from wool?—also to beat it out thoroughly? The wool requires to be treated directly after leaving the stove, but the staple must not be broken. Would a winnowing machine be of any service?—Country Fellmonger.

[51996.]—**Drying Crystals.**—Wanted to dry, or calcine, 30 to 40cwt. of crystals per week. Our present system consists of a brick kiln, heated by coal, the flues being returned twice above, and below a central compartment, containing eight iron circular open topped pans, revolving slowly; these hold about 35lb. each, and will do two or three charges per day, with a heat of 300 Fahr. They require a man's almost constant attention, stirring them three or four times an hour to prevent the small and the bottom of the pan from browning. Can any reader suggest (1) a better system of heating by steam, or otherwise? (2) any different kind of pans. (3) An automatic arrangement for thoroughly stirring the whole. Any information, with sketch if possible, and whether tried or not, will oblige.—Amylin.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 10, and unacknowledged elsewhere:—

H. S. Walter.—H. B. Fulton.—T. Bastow.—T. Richards and Co.—Kell, Meats and Co.—H. Milner.—J. G. Nicholle.—L. A. Eddie.—F. H. Cowle.—E. P. Alexander.—Volta-Metre.—Rev. Jas. Pearson.—Jas. MacNab.—S. Mills.—Wm. Archbutt.—A. S.—A. Best.—W. Hardie.—F. G.—S. Bottone.—J. C. H.—H. Faulds.—Oudeis.—Richmond.—T B.—T. T.—Bilston. Alpha.—A Would-Be Fat-Extractor.—Codadad.—Amateur Millwright.—J. D.—Simplex.—Eta Orionis.—Spark.—Brass.

A. S. (The query has been answered many times: once or twice in each volume, we should think. Try pp. 506, 529, 552, 577, 599, Vol. XXXV. 2. There is no book answering the description.)—Horace Claydon. (You will find one process given last week, p. 101, and many others by searching the indices.)—B. G. W. (See the index to the last volume, and also pp. 508, 552, 574, 597, Vol. XXXVI.)—Petro. (By "lenitiv
tuary" is usually understood confection of senn
that is a very doubtful compound as
recipe is senna 8oz., corianders 4oz.
separate with a sieve 10oz. of mixed
of figs and 3oz. of bruised fresh liquo
of water until reduced to about a half
and reduce still more by gentle heat
sugar and ½lb. each of prepar
prunes. Remove from heat,
add the powder, gradually
thoroughly mixed.)—O. W
clear what it is you mean
instrument, see pp. 120, 1
"Manual of Instruction i
6d. There is a full descripti

Liverpool. (We do not recognise the book from the title you give; but probably some of the music dealers in your city can answer your questions.)—A Country Carpenter. (Better take the advice of your "doctor," who will know what kind of truss is best, and where to get it." 2. Size in the usual way, and give it a coat or two of best copal.)—Africa. (1 No. It is not suitable, as it gives a powerful current for a short time only. Get a Daniell, and look up the indices. See pp. 237, 261, 285, 308, 381, Vol. XXXIV. 2. Watt's "Electro-Metallurgy," Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 2s 6d.)—Ignoramus. (For electric bells, see list of Back Numbers in this column last week.)—Inquirer, J. H. (If they have been plated originally, replating is the only cure. You can try polishing with the brush and rouge, and if that does not improve them, the plating is worn off. You will find a number of recipes in back volumes for washing and dipping such things.)—Inquirer, W. H. L. (A small dynamo to do only what you want has not yet been made, we believe, because to do so much it must be large enough to do more. See the indices of Vols. XXXV. and XXXVI.; also the articles now being issued.)—Gas Engineer. (Bunsen battery best for the purpose, but cells must be placed where the fumes are not a nuisance. Your question is too general to answer fully, as the size of battery depends on the lamp you intend to use. You will find all needful information in back numbers.)—J. McE. (1. We do not remember to have seen proportions stated. Most people find out what is suitable by "trying." 2. Captain Galton's paper was read at a meeting of the Institution of Mechanical Engineers on April 24, 1879, and is presumably to be found in the "Transactions" of that society. You will, however, find "all about it" in back volumes, and some special notes on pp. 187, 212, 280, Vol. XXIX. 3. We believe the address is the Electric Power Storage Co., 4, Great Winchester-street, E.C. 4. The Westinghouse brake has been illustrated and described in many numbers, as parts were improved or altered. Look through the indices, commencing with pp. 578, 627, Vol. XXVI. You can obtain an illustrated description from the company.)—Generator. (You must refer to back numbers for information of that kind, and study the series of articles now being issued.)—Enquirer. (Glue one part, glycerine four parts, whiting to colour. See list of Back Numbers given in this column last week.)—Painter. (What do you mean by "common varnish"? see the indices.)—L. S. (No one can tell you what is the matter from so bare a statement; and surely you would not be so foolish as to try any remedy that might be suggested. There is nothing very remarkable in the symptoms; but if they continue, consult an eye surgeon.)—One in a Fix. (See p. 330, Vol. XXI. You do not require a bellows at all. Simply a piece of wood with a bit of wire and a lead weight stuck in one end, the other being hinged. As the wind is forced past this valve will "tremble.")—B. H. (Mr. Lancaster will probably give them as soon as he has time. 2. The generally received opinion is that the current passes from the zinc through the liquid to the carbon or copper, and thence by the connecting wire back to the zinc.)—N. O. B. (Your question is not very clear, but the stickiness depends on the paint; add gold size or copal varnish to your colours.)—Ego Nemo. (It depends on so many things that it is impossible to answer the question definitely. A large magnet would give more power than two half the size. Look up the question in back numbers.)—Novice. (We cannot form an idea of what you want. Procure a list from Mr. Van Voorst, Paternoster-row, and see if it contains anything likely to suit.)—A. M. S. (The telectroscope was illustrated and described on p. 584, No. 829. Nothing very practical has come of it yet.)—C. B. (It is solution of nitrate of mercury. The "polish" is not permanent, but the application of the solution has the effect of rotting the metal.)—Iota. (You should read up the subject in back numbers. The report referred to is no doubt to be had of the Queen's Printers, East Harding-street, E.C.)—A Lover of "Ours." (Why did you not say so before? They are gaspipes, and have nothing to do with the brakes. 2. We really have no space to spare for the question about corns and rainy weather. 3. What is the explanation needed? The arrangement is common; one high-pressure and two low-pressure cylinders.)—Anxious One. (Get examined by a medical man.)—An Amateur E. P. (You should look through recent volumes. Make it of slate; if of lead, it must be burned; that is, the joint made with lead. 2. Polishing buffs in the lathe.)—Buchan. (Apply to the booksellers, if you mean books. There is the *Chess Player's Chronicle* and the *Chess Monthly*.)—H. (The best treatment is that which will be recommended by medical men after examination. After a time local changes in nervous parts take place, and then a cure is almost impossible.)—W. B. (Pale gold lacquer: 1 gallon of spirit, 10oz. of seedlac, and ½oz. red sanders. The substance to be coated must be made as hot as can be held.)—Student. (Surely you ought to be able to answer for one of the places! There is no special library of the kind in London, but most of the good libraries have scientific books.)—A. B. C. (Subject has been frequently mentioned in these pages, but nothing satisfactory elicited. On the contrary, the general opinion seems to be that gas or fuel are the only trustworthy agents.)—R. F. Eaton. (You mean putty powder. It is calcined peroxide of tin.)—Old Subscriber. (It is crushed by stamping mills, and sifted through sieves of different mesh.)—R. J. (Do you mean they are simply dull, or that the tin is worn off. If the latter, it would scarcely be worth while re-tinning.)
(Clothes are necessary, if supplied accord-
station of life and the parents' means,
will have to pay.)—Jas. Wright.
at once, but we believe other
a subscriber's letter. The
uld probably inform you
e father is responsible.)
address is East Hard-
r the rest. You had
s of a good patent
can be searched, and
Office, South-
y free.)—

inadequate one, and that the father ought to pay more." E. H. (There are so many cheap and good treatises, that we hesitate to occupy space with such a series which would be of little value to the majority of our readers.) Arthur Mee. (Thanks; but many better and simpler have already been given, and we are very full just now.) E. Landon. (Thanks; you will see a correspondent sends a note.)

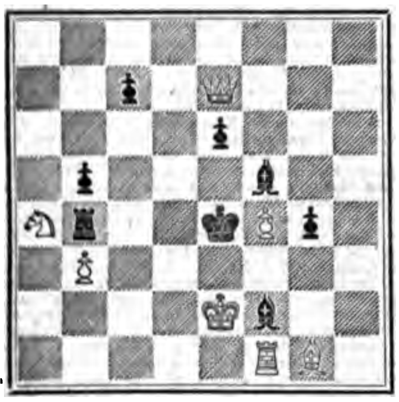
CHESS.

◆◆◆

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLVI. - Else.

Black.



White. [7+8

White to play and mate in two moves.

Solution to 854.

White.		*Black.*
1. P Q B 4		1. K-Q Kt 5 (*a*)
2. Kt takes P (ch)		2. Kt takes Kt mate
	(*a*)	1. Q takes Q P (*b*)
2. Q takes P (ch)		2. R or Q takes Q, or Q covers, mate
	(*b*)	1. Anything else
2. Q or Kt × P		2. Mates

NOTICES TO CORRESPONDENTS.

Correct Solutions to 852 by F. P. P. (2nd solution); to 854 by Mortimer, C. Planck (duals in strong force: White is so hemmed in that Black has to do all he can to avoid mating in *one* move), R. A. Bennett, S. Seymour Follwell (not very difficult).

English Mechanic Tourney game between Mr. Studd (*White*) and Mr. Vincent (*Black*):—

(Evan's Gambit declined.)

1. P-K 4, P K 4 2. Kt-K B 3, Kt-Q B 3/3. B-B 4, B-B 4/4. P-Q Kt 4, B-Kt 3 5. P Q B 4, P-Q R 3/6. P-B 3, Kt-B 3/7. P Q 3, P-Q 3/8. P-R 3 (*a*), P-K R 3/9. Q Kt Q 2, Kt-K 2 10. Q-Kt 3 (*b*), Castles 11. P-K Kt 4 (*c*), P Q B 3 12. Q-B 2, P Q 4 13. P takes P, P takes P 14. B-Kt 3, Kt-Kt 3 (*d*) 15. P-B 4 (*e*), P-K 5 16. P takes K P, P takes K P 17. P-B 5 B-B 2 18. P-K Kt 5 (*f*), P takes Kt 19. Q takes Kt, Q-K 2 (ch) 20. K-Q sq, Q-K 7 (ch) 21. K-B 2, Q-K 4 22. B-Kt 2, B B 4 (ch) (*g*) 23. K-B sq, Q B 5/24. Q takes B, Q takes Q/25. P takes Kt, B B 5 26. Resigns.

Notes.

(*a*) Too defensive. We prefer Q-Kt 3, followed by Castling.

(*b*) B R 2 would be less cramping, or Q-B 2; as it is, the Q has to retreat two moves subsequently.

(*c*) Very compromising.

(*d*) Black has already the better game.

(*e*) Having ventured so far, White might have risked P K Kt 5.

(*f*) White should have seized the opportunity and Castled: even Kt R 2 or B B 4 would have been safer.

(*g*) This seals his opponent's doom.

Longevity.—A Venerable Dame.—At Auberive-en-Royans, a village in the Dauphiné, situated between Valence and Grenoble, may be seen an old woman living in a hut in a narrow street who has reached the extraordinary age of 123. She has no infirmity except slight deafness, being in full possession of her mental faculties. Her age, as given above, is authentic, and according to her marriage certificate she completed, in January last, her 100th year since marriage. The old lady was a "cantinière" under the First Empire, and had two sons killed at the battles of Friedland and in Spain. She is supported entirely on the alms given her by visitors, who go from great distances to see her as an object of curiosity, and her neighbours help her to do her household work. She lives almost exclusively on soup made with bread, to which is added a little wine and sometimes a little brandy. Dr. Bonne, who practises in the neighbourhood, states that she is never ill. Her skin is like parchment, but she is comparatively upright, and is of scrupulously clean habits.—*Lancet*.

SPECIAL ANNOUNCEMENT.—Every Purchaser will be entitled to receive a copy of our GRAND WINTER CATALOGUE, illustrated with upwards of 200 engravings of Specialities and Novelties for personal and domestic use.

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For COMPACTNESS ELEGANCE, USEFULNESS, and QUALITY, no knife has been manufactured to surpass the article we offer. They are of superior Sheffield manufacture, and comprise the following useful articles: Two Blades of the finest steel, Corkscrew, Rimer, Stone Extractor, Cork-squeezer, Nutcracker, and Screw-driver. The handles can be had in either white or stag, beautifully mounted with a Nickel-Silver Plate, on which we will engrave any Name or Initials FREE OF CHARGE. As we have made this offer in order to clear out our enormous stock, we trust that the thousands of readers of the English Mechanic will liberally respond by sending for a sample to show their friends, and we guarantee to satisfy and ASTONISH every purchaser.

We have the knives in three different qualities:—

A contains all the implements mentioned above. Price 2s. 6d., or 33 stamps.

B contains, in addition to the above mentioned Tools, a pair of Tweezers and a Toothpick, and all the implements are of a superior quality. Price 3s. 6d., or 45 stamps.

C contains a great variety of implements, including Saw, Gimlet, and all the Tools mentioned above. It is of the *very best* quality, and the handle can be had in either ivory or best buckshorn, with handsome shield. Price 6s. 6d., or 81 stamps.

POCKET NAIL SCISSORS.

The patent having just expired for manufacturing the above pattern folding Nail Scissors, we are enabled to offer them at half the price at which they have hitherto been sold. Each pair opens to the full size of the ordinary nail scissors, and folds up to two inches, and is enclosed in a beautiful leather case, specially made for the purpose, which can be carried in the waistcoat pocket. No purchaser can fail to be delighted with this pretty and useful novelty, and we are so confident in their giving satisfaction, that we will willingly return the money in full to any dissatisfied customer.

They are made in two qualities:—

Plain Steel, complete, with case, price 3s. 6d., or 45 stamps, post free.

Superior Steel, beautifully nickel-plated, with fire-gilt bows (warranted not to wear off), enclosed in handsome leather case, price 5s., or 63 stamps, post free.

A SET OF TOOLS FOR 5s.,

CARRIAGE PAID, 5s. 6d.

By purchasing one of our sets of Braces and Bits the purchaser will be in possession of a complete set of Tools.

The Bits, twelve in number, consist of the following articles:—

Turnscrew, Rimer, Augers, Centre Bits, and a variety of other useful Tools indispensable in every household.

To Carpenters and Amateurs we recommend with every confidence the above set of well made and highly finished Tools.

We will forward the above Carriage Paid, on receipt of P.O.O. for 5s. 6d. (or 69 stamps)—the usual retail price is half-a-guinea.

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THE ARCHIMEDEAN DRILL AND SIX BITS.

PRICE HALF-A-CROWN, CARRIAGE PAID.

Indispensable to every Mechanic and Amateur Carpenter. We warrant the quality and workmanship to be of the best, and anticipate a great demand for this ingenious Amateur's Companion.

Send P.O.O for 2s. 6d. (or 33 stamps), and you will receive a complete set, carriage paid, the next day. Large size, and better quality ditto, price 3s. 6d. (or 45 stamps), carriage paid.

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18, IRONMONGER LANE, CHEAPSIDE,
LONDON, E.C.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills purify the blood, correct the bile, excite a healthy appetite, produce sound sleep, and impart increased energy to both mind and body. The admirable properties of these far-famed Pills are too highly appreciated to require any encomium here, as they are resorted to by rich and poor of every nation.

OUR EXCHANGE COLUMN.

◆◆◆

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆◆◆

Wanted, all kinds of useful **Apparatus**, in exchange for offers or cash.—Caplatzi, Science Depot, Chenies-street, Tottenham-court-road.

Bicycles and Tricycles.—Apollo Sociable, 54 inch, ball bearings, hollow forks; Silver-plated Coventry Defiance; new Greyhound Tricycle, several Children's Tricycles; two Boys' Bicycles; Facile Safety, &c. Exchange.—J. Green and Co., Hull.

Buck's best 5in. **Lathe**, in perfect condition; circular Saw, and quantity of Tools; may be seen at any time. Exchange offers.—A. Vesey, Knockholt, Sevenoaks.

Electric Railway. 2ft. diamet
centre, engine, and bichromate bottle
wanted phonograph, or offers in lathe
Henry-street, Dublin.

4ft. planed iron **Lathe**
plate, 13½ by 10½in.; angle-pl
what offers?—Mitchell, P

Moulding Bo
and light, some wrong
—Mitchell, Park-

Fifteen Volumes
complete, with ind
oaks.

Exhibition, must have rather astonished a good many people when they reflected that such an invention lay dormant for 13 years. In this letter, Reis says that "*any* sound will be reproduced, if strong enough to set the membrane in motion" (the word any being underlined); and as it is known that instruments made after the model of Reis's will transmit speech, it would seem clear that anyone can make and use them without infringing the "monopoly" patent. Prof. Thompson says that Philipp Reis was the undisputed inventor of an instrument which he called the telephone, which can now be used to transmit speech, which was then used to transmit speech, and which was invented on purpose to transmit speech. It seems to us that he has proved his case completely. In order to leave no doubt, Prof. Thompson goes further, and in an appendix he shows that there is not a single telephone in the Exchanges of England in which the fundamental principles of Reis's telephone are not the essential and indispensable features. It will naturally be asked why Reis did not prosecute his invention to commercial success. The answer will be found in the fact that he was only a "poor teacher," and that he was overtaken by severe illness, which ended his career on January 14, 1874. That, however, was 15 years after the telephone had been first described to the Physical Society of Frankfort; and two years afterwards, Bell's instrument (the magneto-telephone) was described in all the scientific papers, and attracted the attention of speculators. The most important exhibition of the telephone was at Giessen, in September, 1864, at the meeting of the German Naturalists' Association; but although experiments were conducted before the most distinguished scientists of Germany and several foreigners, no one save Reis appears to have apprehended the great value of the invention. A few of the public journals noticed the telephone in eulogistic terms; it found its way into the textbooks, and it was lectured upon in all parts of Germany. Besides the extracts from papers and textbooks, Prof. Thompson gives the testimony of nine contemporary witnesses, who were either personally acquainted with Reis or had experimented with his instruments years before the introduction of Bell's telephone. In the Appendices he points out the similarity in principle, the differences in construction between Reis's instruments and the best known telephones, both transmitters and receivers, and in doing so Prof. Thompson has written a chapter which will be very useful to all who wish to study the telephone. A monument was erected in 1878 to the memory of Philipp Reis in Frankfort cemetery by the Physical Society of that city, and when his jubilee is celebrated on the 7th of next January, it may be expected that his claim to be the inventor of the telephone will be recognised on all sides.

Study and Stimulants. Edited by A. Arthur Reade. Manchester: A. Heywood; London: Simpkin, Marshall, and Co.

This is a revised edition, with additions, of a work which may have some influence on the future consumption of alcoholic beverages and tobacco, as there are many people unable to argue out a question for themselves who will follow what they understand to be the practice of some one whom they look up to as a "leader." The opinions recorded in this book are interesting as the personal experiences or idiosyncrasies of men who are more or less well known to the world: their scientific value is very small. The reply of Prof. Tyndall sums up the whole question as succinctly and pertinently as need be. He writes, "With regard to the use of alcohol and tobacco, I *do not think any general rule* can be laid down. Some powerful thinkers are very considerable smokers, while other powerful thinkers would have been damaged, if not ruined, by the practice. A similar remark applies in the case of alcohol. In my opinion, the man is happiest who is so organised as to be able to dispense with the use of both." Others write in a different style to that, and give some details of their personal habits. Thus Mark Twain says he is forty-six and has been an immoderate smoker for thirty-eight years. During the first seven years of his life he had no health, and lived on allopathic medicines; since then he has hardly known what sickness is. The inference is obvious, especially when we find that Mark Twain now smokes three hundred cigars a month, and began with an allowance of one hundred per month. "Professor" Edison, as he is here called, almost invariably chews tobacco as a stimulant when engaged on experimental work, which he does at night. Mr. Reade may gather a few hundred more opinions; but we think he will get nothing more to the purpose than Prof. Tyndall's "opinion," which, it will be seen, did not contain an account of his personal habits.

Saw Mills: their Arrangement and Management. By M. Powis Bale, M.Inst.M.E. London: Crosby Lockwood and Co.

This is a companion volume to the author's "Wood-working Machinery," and will doubtless be found useful by those who desire to invest their capital in the conversion of timber. The book is confined almost exclusively to saw mills, though the author has inserted his viewsas to the best manner of setting the engine and boiler, and has reproduced his rules for engine-drivers and boiler attendants, which, useful in some respects, are rather amusing (to the skilled attendant) in others. The author gives a number of tables and rules which will be found useful; but in most cases the saw-mill owner will have to use his own judgment, and make experiments with his plant. As the book is furnished with an index, it will be a welcome addition to the shelves of the office library.

We have also received the second edition of *Saturated Steam, the Motive Power in Volcanoes and Earthquakes*, by R. A. Peacock, C.E., F.G.S. (E. and F. N. Spon), which contains an important supplement, and is especially interesting now that the disturbances of the earth's crust at Ischia and Sunda Straits have drawn public attention to the question. The work consists of a large number of extracts, by which the author seeks to support his contention that "saturated steam" is the cause of earthquakes and volcanoes.——*The British Navy*, by Sir Thomas Brassey (Longmans), is the fifth volume of a work we have already noticed at considerable length. The present part deals with "British Seamen," especially as found in the merchant service, and is a careful compilation of the opinions of experts and extracts from reports. It forms the concluding volume of a work which will be especially valuable for reference.——*The Chemistry of the Secondary Batteries of Planté and Faure*, by J. H. Gladstone, F.R.S., and A. Tribe, F.I.C. (Macmillan), is a reprint in the "Nature Series" of the classical researches of the authors. It is, we need scarcely say, the most valuable contribution to the theory of the secondary battery yet made.——*Electricity and its Uses*, by J. Munro (the Religious Tract Society), is a popular description of the most noticeable phenomena of electricity, as illustrated by the numerous appliances invented in recent years. For instance, Mr. Munro illustrates and describes the Wimshurst influence machine, which he says is the most remarkable of all plate machines, Edison's and other telephones, Brush and other dynamos, the induction balance, the electric furnace, and Trouvé's appliances for driving his electrical boat. The book gives a very good idea of the present position of practical electricity.——*Practical Electrical Units Popularly Explained*, by Jas. Swinburne (E. and F. N. Spon), is a very useful little handbook which will explain to tyros how calculations are made in connection with electric lighting, &c.——*Building Estates*, by Fowler Maitland (Crosby Lockwood and Co.), is a useful addition to Weale's series, as it gives trustworthy information on the development, sale, purchase, and general management of building land, including the formation of streets and sewers. The work is illustrated with diagrams, which help to render the text comprehensible.——*Farm Roads, Fences, and Gates*, by John Scott (Crosby Lockwood and Co.), is also an addition to Weale's Series, and a complement to the same author's useful works on agricultural subjects. It is very freely illustrated.——*Arithmetical Chemistry*, by C. J. Woodward, B.Sc. (Simpkin, Marshall, and Co.), is the second part of a useful work for both teachers and students of chemistry. The examples are taken chiefly from original memoirs, and from examination papers, and will be found especially useful by private students who lack the advantages supplied in classes.

THE DYNAMO: HOW MADE AND HOW USED.—VI.*

By Selimo R. Bottone.

Soren Hjorth's Machine.

§ 13. The next great step in the development of the dynamo, was the application of the current generated by the armature to the heightening of the magnetism of the magnets which set up that current in the armature. We have seen (§ 7) that a current sent round a mass of soft iron, converts that iron into a magnet, and we find that the intensity of magnetisation, is, up to the point of saturation, proportionate to the quantity of electricity flowing round the iron. We also know that magnets produced by such means (id est, the passage of currents *around* soft iron cores) are much more powerful than permanent steel magnets of equal size and weight. Hence, apart from the question of less expense and greater constancy (for steel magnets gradually lose their power by the continuous motion of the armatures before their poles) there is actually a great gain in efficiency, in employing *electro-magnets*, instead of *permanent magnets*, wherewith to induce the current. In Hjorth's machine, (which was perfected so far back as Oct. 1854) two compound cast-iron magnets A A, Fig. 11, which may or may not be surrounded by a coil of wire, are bolted to the frame of the machine. These magnets are shaped like the letter **C**; and in the gap between the poles rotates a wheel B B, on the circumference of which are fastened several armatures, consisting of soft iron

wound with insulated copper wire.

which are brought out to a pecul

commutator, which rectifies the

produced. The wheel (an

armatures) is caused to rot

rigger C, and driving axle

able armatures, and also

are several soft iron cores

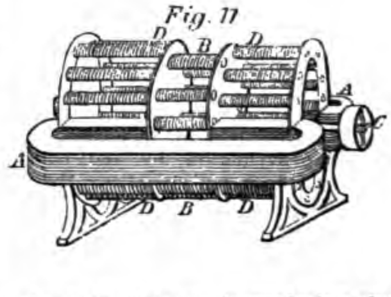
copper wire, D D D D. The

in the first instance by the pas

tures before the poles of the

being rendered uni-d

Fig. 11



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* Ap

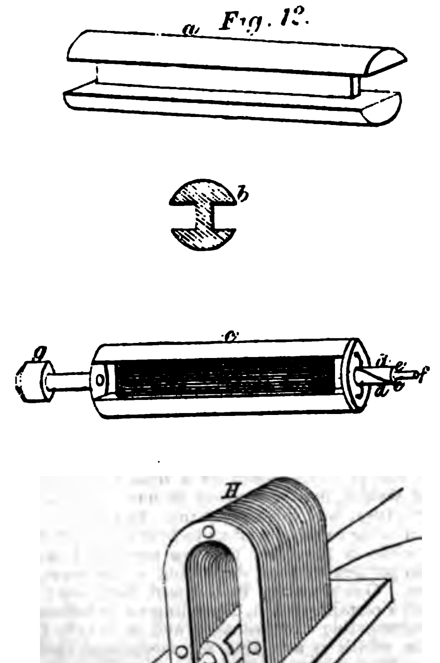
commutator, are led on through wires to the coils which surround the soft iron cores D D D D. These become therefore powerful electro-magnets, and induce in their turn more powerful currents in the armatures. The larger currents thus produced, again reacting in their passage on the electro-magnets, superinduce a higher state of magnetism in them, and this again exalts the electricity generated in the armatures, and so on until the limit of saturation is reached. The current, after traversing the coils, is led to terminals to which connection can be made for exterior work. It is remarkable that although this discovery was so important, and the description and designs were so clear in the specification, so little attention should have been attracted to it. Soren Hjorth was, indeed, much before his time, many of the machines now doing excellent work being simply trifling modifications of his "magneto-electric battery."

The Siemens Armature.

§ 14. The intensity of electric and magnetic effects does not increase in the simple proportion of the nearness of the bodies acted on, but in a much greater ratio which, in the case of electrified bodies and permanent magnets, is *directly as the square of the nearness* or (what amounts to the same thing) is *inversely as the square of the distance*. For instance, we find that a magnet which exerts a "pull" of 1lb. on a given piece of iron at 6in., if placed at 3in., or *twice* the nearness, pulls with a force of 2 × 2 = 4lb., and if placed *four* times as near, namely, $1\frac{1}{2}$in., pulls with a force of 4 × 4 = 16lb.

It would appear that in the case of electro-magnets, the ratio between the distance and the effect increases even more rapidly, being, according to the best authorities, equal to *inversely the cube of the distance* nearly. Hence, it struck Dr. Werner Siemens, of Berlin, that if the armature could be constructed of such a form as to allow of its remaining always very close to the poles of the magnet during its rotation, greatly exalted electrical effects would result, and in 1856 he patented in this country the special form of armature represented

Fig. 12.



[illegible] Fig. 12a, so well known as the "Siemens" or "[illegible]" armature. On re- [illegible] portion of the armature is exposed to the action of the said poles. The Siemens armature, as shown at Fig. 12*a*, consists of a cylinder of soft iron, between three and four times as long as its diameter, around the sides and ends of which is cut a deep groove or channel, rather more than one-third the diameter of the cylinder. This is shown in section at *b*. The soft iron cylinder, *c*, has brass heads and axes fitted to it, as shown at *f* and *g*—the latter carrying a pulley or *rigger*, by which the armature can be rotated; while the former is encircled by the commutator, *c c*, to which are attached the two ends of the insulated wire, which is wound in the channel. When in action this armature is placed between the poles of a compound horseshoe magnet, and supported on trunnions or bearings at both ends; two springs pressing against the commutator carry off the electricity generated by the rotation of the armature, the motion being imparted by means of a band passing over the pulley at the farther end of the armature. A general idea of this arrangement may be gathered by inspecting Fig. 12 H.

RECOVERY OF PHOSPHATES FROM SLAG.

THE successful attempts made in recent years to remove the phosphorus from iron in the course of manufacture by the basic process have naturally attracted the attention of chemists to the possibility of recovering the valuable manure, phosphoric acid, from the slag. A patent has been recently obtained by Mr. S. G. Thomas and Mr. T. Twynam for improvements in the manufacture of phosphoric acid and phosphates from slag, especially adapted to their recovery from slags produced in the basic Bessemer and Siemens processes. The slag is first finely ground, and the particles of iron picked out by means of magnets; it is then treated with sufficient hydrochloric acid, either in aqueous solution or in the gaseous state, to dissolve out the phosphoric acid together with part of the oxides of iron. The powdered slag may first be roasted in a rotary or other calciner, so as to oxidise the ferrous oxide contained in it. If there be not sufficient ferric oxide present in the solution to combine with all the phosphoric acid, it will be necessary either to add some ferric oxide or puddler's slag (which should preferably have been first roasted), or to oxidise part or the whole of any ferrous oxide there may be present, either by chlorine gas or by the addition of manganese binoxide (in which latter case there must be sufficient free acid in the solution to cause the decomposition of the manganese binoxide and set free chlorine), or the ferrous oxide may be oxidised by injecting air into the solution, or by other well-known means. The solution is then run off from any insoluble residue, and a sufficient quantity of lime or (preferably) chalk is added to it to cause the precipitation of ferric phosphate (magnesian lime or limestone may be used in place of ordinary limestone for this purpose, the magnesia dissolved being afterwards precipitated by lime). The precipitation of the ferric phosphate may be effected in the cold, keeping the solution well agitated; a gentle heat however causes the precipitate to settle down better. When the precipitation is complete the ferric phosphate is separated from the solution by filtration, and washed to free it from calcic chloride. The precipitate is then dried so as to drive off all its water and digested with a considerable excess of sulphuric acid, so as to decompose it into phosphoric acid and sulphate of iron, which latter is insoluble in the excess of sulphuric acid employed. Ordinary chamber acid is able to effect this decomposition, but a stronger acid, such as is obtained when using a Glover tower, is better adapted for the purpose. The ferric phosphate should be kept well agitated in the liquid, which may be gently heated to facilitate the decomposition. When the ferric phosphate is considered to be completely decomposed the insoluble ferric sulphate is separated from the solution containing the phosphoric acid and excess [illegible] sulphuric acid by means of a filter press or [illegible]therwise. The filtrate will be found to contain [illegible] all the phosphoric acid in a free state, with the excess of sulphuric acid, from [illegible] be separated by the aid of heat, the [illegible] driven off and condensed, [illegible] acid practically pure, or [illegible] he mixed acids may be [illegible]huric acid for making super-phosphate of lime. The sulphate of iron precipitate after being washed with sulphuric acid may be decomposed by heat into ferric oxide and fuming sulphuric acid, or it may be mixed with salt and heated to form sodic sulphate. In some cases, when there is no lime in the slag employed (as when treating puddler's cinder), the phosphoric acid is thrown down as a mixed ferrous and ferric phosphate by means of lime without previous oxidation, and is then dried and treated in the same way as ferric phosphate.

PATTERN MAKING.—XVI.

(*Continued from page* 52.)

Miscellaneous Engine Work.

BEYOND the cylinder pattern, the pattern of its bed, and the flywheel, there is nothing difficult or intricate from the pattern maker's point of view. Hence we shall run rapidly through the only items that call for remark in connection with an ordinary engine, comprising them in the compass of a single article.

Double eccentric sheaves, forward and backward, are cast together. The pattern itself consists simply of two plain discs, dowelled together—the grooves being turned out in the casting. But the dowelling together of the discs requires care. Proceed thus:—Say we have an engine with $\frac{3}{8}$in. lap, $\frac{1}{16}$ lead, and $2\frac{1}{4}$in. throw of sheave. Strike a circle $2\frac{1}{4}$in. diam., and draw a line through its centre, Fig. 76, at a distance away from this line = $\frac{7}{16}$ = lap and lead, and parallel with it draw another line. The two points where this second line cuts the $2\frac{1}{4}$in. circle will be the centres of the two sheaves, forward and backward respectively. Strike the circle representing their diameters; lay one disc on the drawing on its proper circle, and dowel the other upon it perpendicularly over its circle, adjusting it with set square. Put the print for the shaft-hole on the pattern for one pair of sheaves first, say right-hand. Cast one off, then remove the print to the other centre for the left-hand.

As small eccentric straps, Fig. 77, are usually made in gun-metal, the grooves in many instances are cut out in the pattern. The neatest way to get out the inside of the strap with its grooves is to turn it; but as an allowance for facing is given in the joint, which makes the pattern $\frac{1}{16}$in. more than a half circle, the straps are turned a half at a time, a false block being screwed on the face plate to complete the circle, its face standing $\frac{1}{16}$in. back from the centre line while the two half straps are being turned in succession. The outside portion, with its lugs for bolting together, is worked by hand away from the lathe. The lug or facing for eccentric-rod, and the oil-cup boss are put on separately. Straps are moulded at pleasure either on their sides or edges—the latter giving, as a rule, the cleanest metal.

Slide-valves of the D shaped type are in commonest use. Gridiron valves, balanced valves, &c., are too simple to cause any trouble to the pattern maker—accuracy being the only important condition. The usual D-shaped valve is the only one that calls for special notice. A glance at the sketch (Fig. 78) will indicate the way in which it is made. The block (Fig. 78) A, forming the inner portion of the valve is planed to width, marked out and worked through with gouge and chisel. The sides B B are also worked to shape and then fastened to the block. The piece C, for reception of the valve-rod head, is fastened in place, and a print for the nut core bradded on. An allowance of $\frac{1}{8}$in. is made on the face D for planing, and the same at ends E E, for accurate cut off; a similar allowance also at sides F F for close fitting into the steam chest.

A D valve, like Fig. 79, is made in a similar way, only that, after the D shape is worked, a half-round piece *a* is glued within, and when dry, the recess *b* for the valve-rod is worked on the outside—the pieces *c c* being fitted and glued round the curve to form the flat edges and ends of the groove.

A valve, like Fig. 80, is made in three pieces, as in the first instance, or cut out of a solid piece of stuff; but the outside, instead of being worked half-round, is partly turned and partly dressed off by hand. Allowance for turning is made also at A, where the eye of the valve-rod slips over.

An ordinary steam chest calls for no special remark, and of a double-flanged one it is sufficient to note that the bottom flange must be left loose from the body. Patterns also for plain,

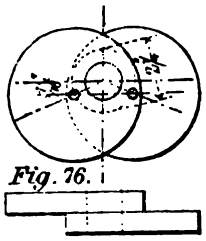


Fig. 76.

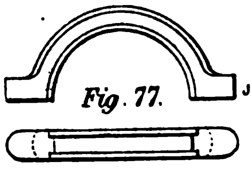


Fig. 77.

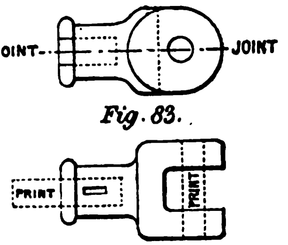


Fig. 83.

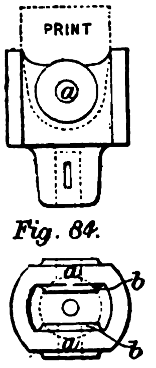


Fig. 84.

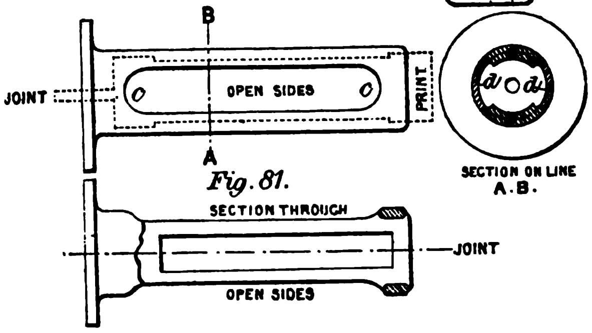


Fig. 81.

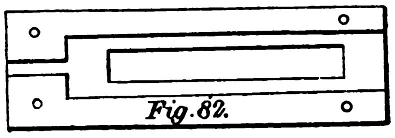


Fig. 82.

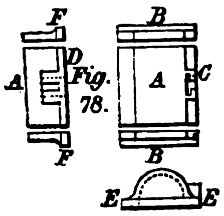


Fig. 78.

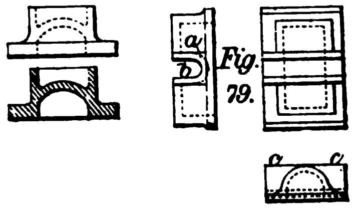


Fig. 79.

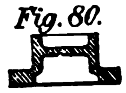


Fig. 80.

flat guide bars are made just like the casting, so we say nothing about them. Instead, however, of the old guide bars, circular guides, bored to receive a circular cross-head, are coming into common use. They are east in a piece with the cylinder cover, have a massive appearance, require little fitting, and owing to the large extent of surface over which the friction of the cross-head is distributed wear for a very long time.

The pattern is made in halves, jointed longitudinally (Fig. 81), and has a print at each end. The open parts of the guide (Fig. 81) C C, are cut in the pattern as far inward as the diameter which corresponds with the body core of the guide (Fig. 81) section, *d d*.

For the core, a box is necessary, owing to the existence of the facings, *e e*, for the cross-head. The box is dowelled in halves, and worked with templets. Fig 82 shows one half, looking into it from the joint.

The cross-head, or head of the piston rod, is of the shape indicated in Fig. 83, when flat guides are used, and like Fig. 84, when it works in a circular guide. In the former case the pattern would be jointed and cut out to the shape of the casting, the holes, if large, being cored with parallel prints. In the latter form (Fig. 84), the inside is taken out with a core, the pattern moulding either on its side or on its end, and requiring no joint. In either case the core box will be jointed longitudinally, and the holes, *a a*, will be cut out in top and bottom boards dowelled on the box body, which boards will also carry the top and bottom bosses, *b b*.

Cranks, brasses, pistons and their rings, slipper blocks, governor castings, except when there is something special in their construction, are too simple to need description from the pattern-maker's point of view; so with this chapter we close our remarks on engine work and pass to other subjects.

THE MAGNETOPHONE.

THE experiments of Bell, Preece, Mercadier, and others on the radiophone suggested to Prof. H. S. Carhart, of Evanstown, Illinois, the possibility of interrupting, or at least periodically modifying, the lines of force proceeding from the poles of a magnet by means of a disc of sheet iron, perforated with a series of equi-distant holes, and rotated so that the holes should pass directly in front of the magnetic pole. It is well known that an armature, placed on the poles of a permanent magnet, diminishes the strength of the external field of force by furnishing superior facilities for the formation of polarised chains of particles from pole to pole. This is the case even when the armature does not touch the poles, but is in close proximity to them. If a piece of sheet iron be placed over the poles of a magnet without touching, and the magnetic curves be developed on paper above the iron, they will be found to exhibit less intense and less sharply defined magnetic action than when the sheet iron is removed. If, however, a small hole be drilled directly over each magnetic pole, the screening action of the sheet iron is modified in much the same way as when a hole is made in a screen opaque to light; for the developed curves show distinctly the outlines of the holes. If, therefore, the sheet iron in the form of a circular plate, pierced with a number of holes, be rapidly rotated between the pole of a magnet and a small induction bobbin, the action of the magnet on the core of the bobbin will be periodically modified because of the passing holes; hence induced currents will flow through a circuit including the bobbin. A disc of sheet iron was pierced with two circles of quarter-inch holes concentric with the disc, the number of holes in the two circles being thirty-two and sixty-four respectively. On one side of the disc was placed a horse-shoe magnet with its poles very near the rows of holes; on the other side were arranged two corresponding induction bobbins. The circuit was completed through a telephone and either bobbin at pleasure. Upon rotating the disc rapidly, a clear musical sound was produced in the telephone, the pitch rising with the rapidity of rotation. Moreover, the bobbin opposite the circle of sixty-four holes gave the octave above the other, and each gave a note of the same pitch as was produced by blowing a stream of air through the corresponding holes. Hence, as a beam of light, focussed upon a circle of equi-distant holes in an opaque disc, is rendered periodically intermittent by the rotation of the disc, and produces a musical tone when falling upon the proper receiving apparatus, so the lines of force proceeding from a magnet may be rendered periodically intermittent in their action on an induction bobbin by a similar metallic disc set in rapid rotation; and the induced currents, arising from the periodic change of magnetism in the core of the bobbin, produce a musical tone in a telephone, the pitch depending in both cases only upon the number of holes passing in unit time.

Non-magnetic metallic discs produce similar musical notes by the periodic modification of the magnetic field by means of the distortion or bending of the lines of force. The solid parts of the conducting disc deflect the lines of force in the direction of the rotation, but upon the passage of a hole they fall back towards their normal position, A periodic movement of the lines of force will, therefore, take place when the disc rotates. Discs of zinc and copper produce a clear musical sound, somewhat less intense than that given by iron under the same conditions. Any discontinuity in the rotating disc recurring periodically will produce corresponding induction currents in the bobbins. Thus, V-shaped notches round the circumference of the disc are quite as efficient as the holes in effecting the requisite modification of the magnetic field. Moreover, it is not necessary that the holes extend entirely through the disc. Two discs of zinc, of the same diameter and thickness, were placed together on the same rotating spindle, one pierced with a circle of holes, and the other not. The combination proved as efficient in producing the sound as the single perforated disc. A sheet of tinfoil, with a circle of small holes, was pasted on the continuous zinc disc. The perforations, extending only the thickness of the tinfoil into the compound disc, constituted a sufficient discontinuity to produce a clear, though somewhat faint, musical sound. About the same result was given by a disc consisting of the same sheet of tinfoil pasted on cardboard. Any periodic variation from uniformity in the disc appears to produce corresponding variations in the magnetic field when the disc is rotated. Depressions made with a punch, at regular intervals, in a zinc disc rendered it a sound-generator when rotated in this apparatus.

Since the pitch of the note obtained depends only on the number of holes passing the pole of the magnet in a second, it is easy to construct a piece of apparatus to illustrate musical intervals. A cylinder of galvanised iron, with four rows of holes in the ratio of 4, 5, 6, 8, was mounted on a whirling table, and provided with two U-magnets and two electro-magnets for induction. The latter were placed inside the cylinder, and the former outside. By means of four keys, any one of the bobbins, or all of them, can be put in circuit with the telephone. By depressing the keys, the four notes of the common or major chord are brought out with great distinctness and clearness. In fact, the intensity of the sounds obtained by the magnetophone is sometimes so great as to be painful to the ear when the telephone is held closely against it. Prof. Carhart describes these experiments in *Science*, and intimates that he is making further investigations.

THE TRANSMISSION OF ENERGY.

I.*

By Prof. OSBORNE REYNOLDS, M.A., F.R.S.

ALTHOUGH the terms energy and power are in continual, we might almost say familiar, use, such use is seldom in strict accordance with their scientific meaning. In many ways the conception of energy has been rendered popular, but a clear idea of the relation of energy to power is difficult. This arises from the extreme generality of the terms; in any particular case the distinction is easy. I was going to say that it is easiest to express this distinction by an analogy; but, as a matter of fact, everything that seems analogous is really an instance of energy. Power may be considered to be directed energy; and we may liken many forms of energy to an excited mob, while the directed forms are likened to a disciplined army. Energy in the form of heat is in the mob form; while energy in the form of a bent spring, or a raised weight, matter moving in one direction, or of electricity, is in the army form. In the one case we can bring the whole effect to bear in any direction, while in the other case we can only bring a certain portion to bear, depending on its concentration. Out of energy in the mob form we may extract a certain portion, depending on its intensity and surrounding circumstances, and it is only this portion which is available for mechanical operations. Now energy in what we may call its natural sources has both these forms. All heat is in the mob form, hence all the energy of chemical separation, which can only be developed by combustion, is in the mob form; and this includes the energy stored in the medium of coal. The combustion of 1lb. of coal yields from ten to twelve million foot-pounds of energy in the mob form of heat; under no circumstances existing at present can all this be directed, nor have we a right, as is often done, to call this the power of coal. What the exact possible power is we do not know, but probably about four-fifths of this, that is to say, from eight to ten million foot-pounds of energy per pound of coal is the extreme limit it can yield under the present conditions of temperature at the earth's surface. But before this energy becomes power it century, who scornfully suggested, as a better explanation, that the fossils which so much exercised the minds of his contemporaries were shells which had fallen out of the hats of pilgrims on their way to Rome. It would be futile to pretend that a natural timidity in the face of bold conclusions was the sole or, indeed, the chief cause which led to the shifty explanations of early writers. There was a reason deeper and more real. That which men had always rightly clung to as their most precious possession was their religious belief, but it unfortunately happened that religion at that time was bound up with a rigid and narrow system of theology, which was at utter variance with all conclusions involving the occurrence of former extensive geographical changes, or a prolonged existence of the stratified rocks. For a long time 6,000 years was the utmost that could be afforded for all the changes that were known to have taken place in the earth's crust. By this period inquiry was limited, thought was not free, and thus for nearly 300 years after the time of Da Vinci the human intellect lay helplessly bound by the enchantments of a dogma which, after all, had no real theological basis. There were, however, at intervals minds over which dogma had no power. The Huguenôt Bernard Palissy, fifty years or so after Da Vinci, arrived at the same conclusion as he had done with regard to the nature of fossils and the formation of stratified rocks, but no great advance was made till 1669, when Steno, a Dane, who was professor of anatony at Padua, by investigations not only went so far as his predecessors' conclusions, but pointed out that the lowest stratum in any group regularly placed one on another was the oldest, and at the time of its formation the overlying beds did not exist; he showed also that strata were deposited horizontally, and declared that some strata which were removed from the horizontal position had had their position changed from the horizontal one after their deposition. This seemed a very obvious conclusion, but amongst geologists the faculty of perceiving obvious conclusions was a rare endowment, as was shown by the fact that 150 years after Steno they were bent on arguing that inclined strata were deposited in the position in which they now occur, and it was not till beds of pebbles standing vertically in the Alps were noticed that these "biind moles" were enabled to perceive the obvious conclusion of Steno. Steno also pointed out that sediment deposited in the sea must be bounded below by what was once the seafloor, and laterally by what was originally the seacoast, an inference far from generally accepted till long after the beginning of the present century. He traced 14 separate strata in the Tuscan valleys, and this with his suggestions as to their geologic history was his great work: shining like a brilliant light he seemed to only render the gloom of the middle of the 17th century the darker. Arduino, in 1760, made another step in the work of classification; he divided the rocks into three groups, primary, secondary, and tertiary, and distinguished between the igneous and aqueous rocks. It was left to Dr. Smith, the father of English geology, to prove that particular groups of fossils definitely characterised particular groups of stratified rocks, a fact of the utmost importance. This had been no doubt intimated by Werner, but Dr. Smith illustrated it and practically applied it by making the first geological map of England. While the phenomena of the earth's crust were thus the subject of more or less successful investigations a search was continually made for some single explanation wide enough to embrace them all. Most of these creeds were crude enough, wretched travesties of the Mosaic account of the Creation. The wild ideas of cosmogonists, who busied themselves in inventing imaginary systems instead of carefully investigating existing facts, had a pernicious effect on the growth of geology, which became lost in a maze of conjecture. A hundred and twenty years after Steno arose the master mind of Hutton, who determined faithfully to explain the records of the past by an appeal to the present. He ascribed the wonderful changes that had taken place on the earth's surface to the action of such natural forces as streams, rain, and air; then the value of time in these changes was shown, and Hutton declared the immense antiquity of the world. Hutton formed the uniformitarian school, opposed to which were the teachings of the catastrophists, in the eyes of whom the condition of the earth proved numerous and terrible convulsions, floods, and earthquakes to have been the operating cause of change. With the death of Sir R. Murchison this latter school became extinct, at least in Britain. Hutton, knowing little of the gradual upheaval or depression of the earth's crust, had to call in the aid of the catastrophist to account for evident changes in the position of strata, and in his view alternating with long periods of the calm, quiet working of natural forces, were sharp convulsive catastrophes, which produced abrupt and tremendous changes. Lyell strengthened the Huttonian doctrines in their weak part, and showed the upheavals and depressions to have been for the most part very gradual, and, carrying the uniformitarian doctrines into the very arena of catastrophism, pointed out that even volcanoes were built up of ashes and lava accumulating round an orifice like a gigantic dust heap. Ramsay removed other difficulties of the system, and showed to what a planing action the earlier formations had been subject by the destructive power of the sea. A map showing the condition of the earth's surface between Usk and the Forest of Dean, for instance, before this planing process, included great elevations—mountains 12,000ft. high, where the ground was now nearly level. The objections to Hutton's teaching were one by one removed; but, victorious as the school proved, it had mistakes. One was that it had nothing to do with the beginning of things; it divorced itself entirely from cosmogony. Lyell made the great mistake of supposing that the forces of the past were not only the same as at present, but in the same degree, and incalculable calls were made on the assets of the uniformitarian school in the bank of time. On this question the much despised cosmogonist had something to say, and Sir William Thomson was able to show that the period since which the solid crust first forced over the molten interior of their planet was not so incalculably long—possibly much less than a hundred million years. All this time other sciences were making great progress; the indestructibility of matter had been accepted; Darwin's hypothesis of evolution had triumphed. In the evolutional school the long-opposed catastrophism and uniformitarianism found a final reconciliation, and cosmogony was once more joined to geology with the benediction of the physicist, while physical geography retained the honourable place allotted to it by Hutton. The history of geology was the history of a number of successive approximations towards the truth; each stage had been a stage of infancy in relation to its successor, and he saw no reason to believe that the evolutionist school of today might not be replaced by that of a far truer system in a no very distant to-morrow. In concluding, Professor Sollas ran over the geological views on the history of the earth, and showed how wide was the field of geological reasearch, and how it embraced within it most of the other sciences.

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* Abstracted from the Cantor Lectures delive
the Society of Arts.

USEFUL AND SCIENTIFIC NOTES.

Hereditary Short-Sightedness.—Dr. Cohn has, in a recent number of the *Gesundheit*, summarised various statistics on the question of hereditary short-sightedness, which have from time to time been collected by Erisman, Scheiding, Pflüger, and other authorities on the subject. The researches of the last-named writer resulted in the following facts being elucidated as to the percentage of shortsighted pupils:—Public schools: Without predisposition, 8 per cent.; with predisposition, 19 per cent. Higher schools: Without predisposition, 17 per cent.; with predisposition, 26 per cent. The difference of about 10 per cent. in favour of those children without an hereditary predisposition to shortsightedness is, according to Pflüger's opinion, a reliable basis of argument. At the same time, he asserts that this relatively low figure is arrived at after the necessary elimination of those cases where the predisposition has remained latent, and where it is of such a nature as only to become the source of ocular affection under circumstances of an unfavourable character.

Position in Sleep.—A correspondent has called attention to a statement recently made in regard to the custom mentioned in the Jewish writings of sleeping with the head and feet directed to the north and south. Unfortunately there is some discrepancy in opinion amongst those who advocate this position during sleep. The Hindoos, it is said, believe that to sleep with the head to the north will cause one's days to be shortened, to the south will bring longevity; on the other hand, a physician who died at Magdeburg at the advanced age of 109 (*pace* Thoms) declares in his will that he owed the protraction of his term of life to the fact of his frequently assuming the recumbent position with the head to the North Pole, by which means the magnetic currents pervading the globe are enabled to exert a certain influence on the iron contained in the body. Dr. Reichenbach's odylic force seems to have been similar in its fundamental idea with this, and Dr. Rogers asserts that invalid children with little disposition to sleep may be induced to do so by placing their cots due north and south, with the child's head to the north. There may be some truth in this popular superstition, but we think we can recall some occasions where, though the child assumed every possible position in regard to the magnetic meridian, the "od" force, if acting at all, did anything but conduce to sleep. —*Lancet.*

Sodawater and Ice Machinery.—Messrs. Barnett & Foster, of Eagle Wharf-road, N., have issued a new and voluminous catalogue of the machines and appliances used in the "mineral water" trade—a rather elastic term, which covers a great deal nowadays. However, anyone wishing to know what ingenious contrivances are provided nowadays for the manufacture of drinks and for bottling them, will find them in this catalogue, in which everything that can be needed in the most elaborate factory is illustrated and described.

SCIENTIFIC NEWS.

THE memorandum containing a proposal for the establishment of a marine zoological observatory, which has been presented to the executive committee of the Fisheries Exhibition, is signed by nearly every distinguished zoologist in this country, except those having official connection with the exhibition. The proposal asks for a minimum sum of £20,000 to build and equip a zoological observatory, and to provide for the salaries of the director and his subordinates. Accommodation would be provided for, say, six naturalists, who might desire to avail themselves of the opportunity of acquiring knowledge, and who would pay fees for the use of the laboratory and other appliances of the establishment. Many persons will consider that besides the study of marine zoology, the surplus funds of the Fisheries Exhibition should be devoted to establishing breeding stations, at which the more valuable kinds of fish would be artificially hatched and distributed to all parts.

An international maritime exhibition will be held in the Palais de l'Industrie, Marseilles, from Nov. 15 to April 30. It will embrace everything connected with navigation and also the produce of salt and fresh waters. Particulars can be obtained of M. Lorgeas, Palais de l'Industrie, Marseilles.

The Rev. J. G. Wood sails for Boston this week to fill the post of Lowell Lecturer. After performing the duties of that office, he will deliver a course of lectures at the Cooper Institution, New York, and subsequently make a tour through North America.

The directors of the Ben Nevis observatory have published an account of the scheme in a handy form, which serves as a ticket entitling the holder to the use of the new path, by means of which the ascent can be accomplished with comparative ease in about a little more than two hours. The path is six feet wide, and the gradient is nowhere more than one in five.

The Western Microscopical Club held the first winter meeting on Oct. 8th, at the house of Mr. W. S. Gwinnell, F.M.S., F.A.S., the special subject of the evening being the microscopical structure of rocks. Amongst the rock sections were granites, syenites, trachytes, basalts, &c. together with some interesting sands and ooze deposits. A series of drawings of the same was also exhibited, as well as an extensive and representative collection of fossils, containing many fine and some almost unique specimens. Prof. Boulger, F.L.S., exhibited a beautifully-mounted skeleton of the common frog. Microscopical slides, illustrative of rock structure, were shown by Messrs. Gwinnell, Dr. Bartlett, E. Norris, M.R.C.S., and A. W. Stokes, F.C.S. Among the visitors were Mr. F. W. Rudler, F.G.S., Mr. J. Hogg, B.A., Mr. Norris, M.R.C.S. The next meeting will be on Nov. 5, at the house of Mr. William Crookes, F.R.S., when the subject will be "Recent Discoveries in High Vacua."

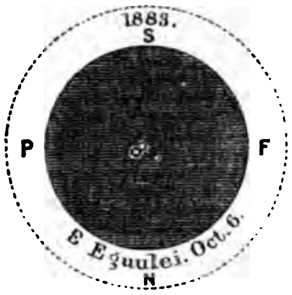
Mr. E. T. Newton, in the October No. of the *Geological Magazine*, describes the recent discovery of teeth of the cave hyæna in the "forest bed" of East Anglia. The relics were found in an excavation at Corton Cliff, Suffolk, by Mr. J. J. Colman. They were associated with remains of *Rhinoceros etruscus*. Mr. Pengelly (p. 102) will probably have something to say about this find, as it must have been known about the time he was delivering his address, in which he took it for granted that no trace of the hyæna had been found in the forest bed.

Dr. Croll replies to Prof. Newcomb and others in the *American Journal of Science* on some controverted points in geological climatology.

A remarkable heat-wave was experienced in Scotland last week, the temperature rising from 13 to 21° above the average of the previous week, and at Aberdeen reaching a maximum of 72°. The temperatures recorded are exceptional so far north in October.

The invitation of the President of the United States, for an international conference on a prime meridian to be held at Washington some time next year, does not appear to have been responded to very cordially. Neither Italy, Russia, Germany, France, or Great Britain have yet replied; Austria, Sweden, and Norway have declined, though the Scandinavian countries approve the

The night being for a few hours after dark exceptionally fine and still, I turned my mirror on that most interesting triple ε Equulei. It is rather singular that both the Herschels observed and measured this star as a double, and missed altogether the fact that it, the chief star, is itself a close binary. It was not till 1835 that Σ discovered that such is the case, and, with a power of 800, elongated the disc, measuring the distance then as 0·4″. Since then the components have separated up to 1·04″ in 1859, while at present, if later measurements are correct, A and B are only 0·83″ apart. I was pleased to find that my instrument, with a power of 250, did more than elongate—separated the discs with a dark line intervening, while with 450 they were resolved into two beautiful suns, well divided from each other. I give a sketch of this magnificent triple as it thus appeared. It is an object, even as a double, interesting; but, with sufficient instrumental power to resolve it fully, very beautiful.



Our attention has also been called to Venus. I have been, like Mr. Franks, observing this planet, and only missed it for a few days when utterly lost in the Sun's rays. Now again I see it very distinctly; but I quite agree with the "Writer of the Astronomical Notes," that as a telescopic object it is most uninteresting, in its present position, and worthy of no more notice in the "Monthly Notes" than it has received.

While writing, may I again ask "F.R.A.S." to kindly furnish us, as he did before at my request, with a correct outline of Saturn as it now appears, with ring as open, probably, as it can be. His former outlines furnished a ready help in the filling up of the details observed from time to time. Looking at Σ 2848 Pegasi, there is a rather wide double, *n. f.*, not mentioned by Webb.

Droylsden Rectory. **S. Mills.**

THE LUNAR CRATER ARCHIMEDES.

[21929.]—I am very pleased to find my observation of the prolongation of the streaks of Archimedes confirmed by such well-known authorities on selenographical matters as the Rev. F. B. Allison (letter 21853) and Mr. T. G. Elger (letter 21877.) Considering that the prolongation of the streaks was noticed by Dr. Schmidt so long ago as 1858 (see Mr. C. Gaudibert's letter, No. 21878); and the frequency with which the above-mentioned observer seems to have seen it, together with the present conspicuousness of the phenomenon, it is rather strange that no mention of the prolongation of the streaks is to be found in the very detailed description of this crater in Neison's "Moon"; or in that indispensable handbook for the observer, Webb's "Celestial Objects."

Now, it would be very interesting to know whether this phenomenon was as conspicuous just previous to 1876—the year in which Neison's work was published—as it is at the present time? For it is just possible that the particular portions of the streaks prolonged beyond the wall (if not the whole of the streaks) may periodically vary in brightness; and thus the phenomonon may not have been sufficiently conspicuous about the year 1876 to attract the attention of observers generally.

I wish to call the attention of our selenographical readers to the possibility of the streaks on the floor of Archimedes being variable, not so much because the hypotheses may account for the omission of all mention of their prolongation beyond the wall of the crater in Neison's "Moon"; but because Mr. F. S. Davenport (letter 21822, p. 61), from observations extending over a period of ten years, considers them to be at the present time unusually distinct; and I estimate the two streaks, to which I called attention in my letter, No. 21706, p. 551, Vol. XXXVII., as being fully ½° brighter than Neison considers them to be.

I shall be glad to learn the opinions of the selenographical readers of "ours" on this point; and I trust that Archimedes may be well examined whenever observable during the next lunation.

Dalston, E. **B. J. Hopkins.**

CAMELOPARDALIS.

[21930.]—Looking at stars in Camelopardalis on Oct. 6th, I found a double not mentioned in Webb. I think it is new, because it is so near two well-known doubles that it would almost certainly have been mentioned if seen. It is about as far following 385 as 384 is in advance of it, and the companion is little more distant than 384, and of lesser magnitude, say, 2·5″ and 11th mag. Position, I did not estimate, not thinking it possible it could be new, but, finding since it is unknown to others who have looked at this group, I now think it probable it may be new. Power used, 570 on 8in. of a 9in. mirror.

Perhaps Mr. Franks will kindly say if it is new, and, at the same time, say what is the most reliable present estimate of distance of 400 Camelopardalis. It appears to me much closer than 1·2″.

Would it be troubling Mr. Franks too much to ask him to send a description of his home-made equatorial stand to the "E. M." I think it would interest many besides **Edwin Holmes.**

COMET PONS-BROOKS.

[21931.]—I beg to call attention to a phenomenon but little noticed and less understood, of which the interesting return of the present visitor has already furnished an example—viz., the variation of its brightness. I did not search for the comet until Sept. 23rd, when I quite failed to detect it with a 3in. O.G. of 4ft. focus, though I was looking at the exact spot where it must have been. The next evening I was much surprised to find it an easy object, so bright that it was distinctly visible with a small telescope, nine-tenths of an inch O.G. and ten inches long. Since then it seemed to lose its light gradually, until my last observation, on the 6th inst., when I could only just see it by averted vision, a small star seen directly through it almost entirely overpowering its light. The present moonlight has prevented any further observations.

Bromley-by-Bow, Oct. 15th. **J. Lane.**

RECREATIONS WITH THE SPECTROSCOPE.

[21932.]—It is a matter of some doubt, I take it, whether amateurs are sufficiently aware of the large fund of instructive amusement which is placed at their disposal by the judicious use of that very wonderful instrument. Speculative astronomy is wont to be regaled with the contemplation of the star-clusters, double and triple stars, and nebulæ which every fine evening discloses, and nothing can surpass their awe-inspiring beauty. But those who possess telescopes of 4in. aperture and upwards may have the extent of their researches largely augmented by adapting a spectroscope of eight prisms at least (5 prisms added to 3) direct vision, such as would be supplied by our most celebrated opticians at no exorbitant cost. I have found such an instrument quite available for the purpose of examining star-spectra of the first, and even of the second, magnitude, and this of itself opens out a pleasing variety. It is also useful in studying the phenomena of the *rain-band* in connection with the pamphlet of Mr. J. Rand Capron. The telluric lines, when the sun is low, are simply gorgeous; and the ever-changing aspects of the few black lines on the red side of the sodium line D show that the amount of aqueous vapour in the air is by no means constant, though not many will be able, I fear, to prognosticate changes of weather with the facility which is anticipated by some who have familiarised themselves with the process. But what has delighted me most, and what I recommend to others, is the simplicity with which exquisite views can be obtained of the solar "prominences." These are included in the chromosphere, and consist of two kinds, "eruptive" and "cloud" prominences. The spectroscope is fitted to the telescope in such a way that the image of the sun (not a very large one) is formed at the principal focus of the object-glass, and directly upon the face of the disc which contains the slit. On applying the eye to the small telescope, there are seen *two* spectra—one bright and solar, the other faint and atmospheric, and these two are separated by a line. This line must be *focussed* so as to be *sharp* and *clear*, and then the slit must be sufficiently closed to show the Fraunhofer lines. It remains next to place the slit *tangentially* to the sun's disc, as seen on the slit (a small mirror is useful for this purpose), and then, on opening the slit to its widest extent, and contriving to keep the sun's image within a hair's breadth from the edge of the slit, and just outside of it there will be seen, on a small scale of course, but yet with remarkable distinctness, a lengthened range of solar prominences, some suspended as in mid-air, and some shooting up fantastically from the solar horizon. The spectacle is one which will not be easily forgotten by those who see it for the first time. It reminds one of the golden tints of sunset, only what is beheld seems more pure and brilliant. In fact, the picture presents a marked contrast to anything terrestrial, and is infinitely more dazzling. On using a telescope of 5in. aperture, the only difference was that the effects were increased in consequence of there being a larger image of the sun in the focus. In other respects the results were the same, and there need be no disappointment. What those observers can show us who are in possession of still larger telescopes, I can only imagine; but an amateur will find far more than he ever expected to find within the compass of his more limited efforts, and I trust many will be encouraged to make the attempt to witness them.

James Pearson, M.A., F.R.A.S.
Fleetwood Vicarage, October 8th.

THREE-MANUAL REED ORGAN.

[21933.]—I send you a sketch of a proposed 3-manual suction instrument, thinking that, if of sufficient merit, it might be useful to "G Minor," p. 69, and of interest to some others. I saw the instrument mentioned by "Organon," p. 92, when in course of construction, but cannot say whether the owner surmounted the obvious difficulties connected with the action, or not, and, if he did, I also should like to know how it was done; but I thought at the time it was a mistake to have to shift or altogether remove any portion of the action proper to obtain access to the reeds. This difficulty at least is removed in the accompanying sketch, and should, I think, receive the first consideration in a large instrument; and then the voicing and nomenclature of the various stops should be decided by actual trial in the various tubes—that is, of course, when anything out of the ordinary groove is attempted. The lowest manual, (1) the choir, is shown in the usual position, with two rows of reeds in front, but may have two more at back if the coupler manual to pedal does not come in the way. (2) is the great, working by backfall and pulldown, like a pipe-organ action? This section may be enlarged almost *ad lib.*, by continuing the pulldown up the wind chest (or outside if preferred) to a second and even third set of pallets and squares, as indicated. (3) is the swell acting by a sticker working through the windchest like the great, on to a tilting pallet as shown. Two couplers only are shown; but would, I think, be sufficient—viz., swell to great, between their respective manuals; and swell octave to great (*a*), a set of skewed backfalls to rise and fall. I think it would be a good plan to make the pedal organ large enough to supply the whole of

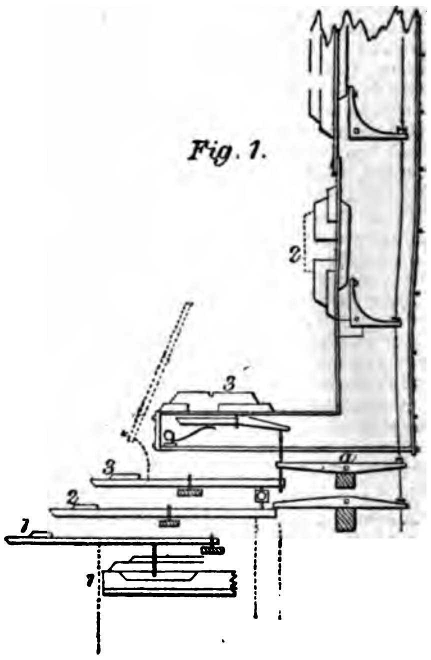


Fig. 1.

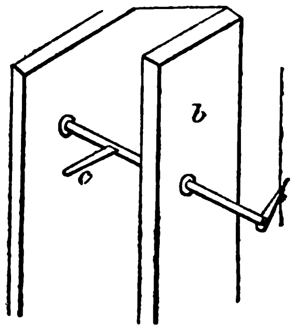


Fig. 2.

not do! The life principle of the bulb is innate, it works, it is capable (as all life is, and this is the essence of life) of appropriating external matter and external energy, and applying them to its own development and reproduction. Sweetness has no existence of its own at all: it is merely an action. The sweetness is not in the sugar, it is a perception by the nerves of taste of some action upon them; there is, therefore, here no "line of reasoning for the disproof of the hypothetical life" for me to admit or to refute.

Mr. Grey says that the materialistic idea has "the merit of unity with what we know of nature." There I most decidedly join issue. Nothing is more certain than the break of continuity in nature at that stage where life is superadded to matter. Mr. Grey will see that his argument from the synthesis of urea is utterly untenable. We all know that energy and the forces play their part in the functions of life, and that the so-called "organic chemistry" is the chemistry of carbon, as carried on in the laboratories of life, and also that it is identical with all other chemistry, but more complex. But no one has, therefore, the shadow of a title to say a word as to the possible synthesis of *life*. It is very possible that we may be able "to-morrow" to make starch for instance: but that would not authorise us to imagine that we should ever make a "starch cell." It is the recognition of this gap, not of degree, but of order, which justifies the belief that some new agent, wholly distinct from matter, but operating upon matter, is the cause of life.

The attribution of this power to "matter" is really "a pure assumption, and, moreover, does not throw any light on the subject." On the contrary, it obscures it because it introduces a complication contrary to all our knowledge of matter. It involves the question, How does matter possess it? Is it a faculty of the *atoms of carbon*, dormant in other actions? If so, how are we to test or prove its existence, if it is developed only where life occurs? Is it a power possessed by matter in the general, but capable of being taken up by the atoms? Then what is the distinction between the two conceptions?

Nature shows us matter and energy: energy is not matter, it is not a property of the atoms of matter; but its own existence is evidenced only by junction with matter, from particle to particle of which it can be transferred. Matter and energy constitute *physics*. Life appears, and appears on this earth after, countless ages of purely physical action. Is it unreasonable to assume that *like energy*, this is a new agent—not matter, nor actions of matter, but operating on matter. That is the assumption of *meta-physics*, "meta" meaning simply "beyond." Why it agrees with the unity of nature. How explain the fact, more certain day by day, that life appears only as a consequence of preceding life?

Sigma.

TRANSFER OF THOUGHT.

[21936.]—"Sigma," in his letter 21903, p. 127, asks me whether I do not see that the quotation from Buchner, anent the production of thought, is nonsense, &c., and again asks me, "What does anyone know about it"? I reply, "'Sigma' does." Has not "Sigma" told us that he knows all about it; that it is an agent working with the senses as a workman does with his tools; or what is all this discussion about? It is no use calling out, "What outrageous trash!" Let "Sigma" calmly marshal his counter-arguments, to prove his "assertions," and I shall be ready to admit their truth, if they be true indeed.

"Jokes" do not constitute proof, nor do they clench an argument. When Buchner says, "in the same manner," it is self-evident to an impartial reader that this means "like"—*i.e.*, as an engine produces "motion" as the result of its activity, so does the "brain" produce "thought" as the result of its activity, although, of course, the "manner" of producing motion by an engine and thought by the brain may be ever so different. It is, no doubt, difficult by a single quotation to give the reader a correct idea of what is its real purport, but I will venture on one more from Buchner:—"The steam engine is, in a certain sense, endowed with life, and produces, as result of a peculiar combination of force-endowed materials, a united effect which we use for our purposes, without, however, being able to see, smell, or touch the effect itself."

Read also what Haeckel says (p. 285):—

"Still, it is often asserted to-day that by these labours only the origin of the human body, but not that of our minds, is explained. In answer to this important objection, we must keep ever in mind the physiological fact that our soul-life is indissolubly bound up with the organisation of our central nervous system. But the latter is composed and is developed in exactly the same manner as is that of all higher vertebrata. Further, according to the researches of Huxley, the differences between man and the higher apes in brain structure are far less than the corresponding differences between the lower and the higher apes. As the function or work of every organ is unthinkable apart from that organ, as function is everywhere developed hand in hand with organ, we are forced to the conclusion that our mental functions have slowly, and with steady ascent, evolved pari passu with the phylogenetic upbuilding of our brain.

"As man has gained a conception of the connection between soul and body, spirit and matter, so the modern theory of evolution goes with its clearer eyesight much further, and teaches us that all organic matter at least, if not matter as a whole, is, in a sense, gifted with a soul. In the first place, improved microscopic investigation has taught us that the structural elements of organisms, the cells have, as a rule, an individual soul life, &c.

"The magnificent and fruitful application of the cell theory, made by Virchow in his cellular pathology, to the domain of theoretical medicine rests on the fact that the cells are no longer regarded as dead, passive building stones in the organism, but as its living, workful citizens.

"This conception is ultimately based upon the study of the infusoria, amœbæ, and other unicellular organisms. For here, in the solitary, isolated cells, we meet with the same outcome of soul life, sensation and consciousness, volition, motion, as in the higher animals composed of many cells, &c. The soul of the plasticule would therefore be the ultimate factor of the organic soul life."

F. W. H.

[21937.]—In common with "Mu." (21905), I have always questioned the utility of semi-spiritualistic performances. I read the articles in former vols. on "Clairvoyance," &c., and the question has always arisen, "Cui bono?" How is it that, with all their pretensions, these learned and clever gentlemen cannot solve a few of the burning problems that have defied the investigations of centuries? For instance, Who was the author of the "Letters of Junius"? Of what trade or profession was Shakespeare?—for has he not been claimed by nearly all of them? Then, again, in modern times, What became of the ill-fated *President*, the *Atalanta*, &c., &c.?—to say nothing of the undiscovered crimes that have startled the present generation. Has any scientific question been settled, any geographical problem solved? I have never heard or read of such. I do not fully share the disbelief of "F.R.A.S." (p. 125); for I have seen a gentleman of unimpeachable integrity, who is peculiarly sensitive of the comments of others, make (to quote the words of his wife, who was present) "a complete fool of himself" before a crowded audience, though, at the same time and place, the lecturer failed to produce any effects (save a little drowsiness) upon—

Lamplighter.

[21938.]—It appears remarkable to those who cannot see in the dark, that "Sigma" should consider Mr. Carter's juvenile friends possessed of rare mesmeric qualities (21856), when the children themselves admit that the "miracles" they perform can be "done" by *all their friends*, and the exception is to find *anyone unable* to do the like (21863). No doubt "Sigma's" opinions are well founded, and, as he says (21903) would be admitted by every sensible person, &c., but "to people of limited scope" it is difficult to understand how a quality can be *rare* when it is *common to all alike*.

T. E. D. Craven.

SPECIFIC GRAVITY—METALLIC PRECIPITATES—CHEMICAL—OXIDE OF COPPER—PREVENTION OF RUST IN FIRE ARMS—ANALYSIS OF DRUGS AND VEGETABLE SUBSTANCES.

[21939.]—"Specific Gravity" (query 51619, page 23) has been partially answered by "N. C. R." The weight of solid sugar, in pounds contained in one gallon of syrup of various specific gravities is commonly ascertained by means of a table, but for solutions of not greater concentration than about 2lb. per gallon (= 20 per cent.) the strength may be found by dividing the excess of density above 1,000 by the constant 38·5. Thus, for example, the specific gravity of standard wort is 1,057 at a temperature of 60° F. (Inland Revenue Act, 1880). Then the pounds of saccharine matter per gallon will be found by the equation $\frac{1057 - 1000}{38\cdot5} = 1\cdot48$

I am not aware that the density of solutions of silver nitrate and sodium carbonate have been determined. "J. R." will find a different equation or table necessary for finding the proportion of each substance.

"Metallic Precipitates" (query 51779) are not obtainable in all cases. Copper is readily precipitated, as pointed out by "No Sig.," by introducing metallic iron into a solution of a copper salt. A purer product is obtained by using zinc instead of iron. Zinc cannot be precipitated in powder by any reasonably cheap process. Magnesium is said to throw it down. Bronze, having the physical characters of the compact alloy, cannot be obtained by precipitation. But if bronze of the required composition were dissolved in aqua regia, and zinc immersed in the solution, the precipitate would contain both the copper and tin of the original alloy.

The information contained in the query, No. 51556, page 22, headed "chemical," is not sufficient to enable me to afford the querist much help. Surely he does not mean that he extracted from a mineral a white substance, that would burn like magnesium with production of a white light! Yet that is what he says. The blue powder, again, I am unable to identify from the description, but suspect tungsten. Tungstic acid is soluble in alkalies, precipitated white by acids, the precipitate turning yellow on boiling. With reducing agents, such as metallic iron or acid, it gives a blue oxide of tungsten.

"Oxide of copper," query 51597, page 22, can scarcely be made in any cheaper way than by heating the metal. Its preparation from the sulphate would certainly be more expensive, and a good deal less simple. Ignition of the nitrate is a good method; but somewhat expensive as compared with the preparation direct from the metal.

"The Prevention of Rust in Firearms" (No. 51722, page 73) is a subject on which I have no practical experience. Theory would lead me to use a grease free from rancidity, salt, or water. This I should look for in mutton dripping or pure lard. Vaseline I should expect to be very suitable, provided it was originally free from any trace of acid. This could be insured by previously melting it with a little lime.

The "Analysis of Drugs and Vegetable Substances" (No. 51819) is far too long and difficult a problem to describe at length in these pages. A systematic method for the proximate analysis of plant products has been described by H. B. Parsons, and will be found in the *Pharmaceutical Journal* [3] X. 793. Much information on Japanese drugs will be found in the same volume, pages 3, 21, 101, 201, and 261.

Sheffield, October 13. **Alfred H. Allen.**

HYDRAULIC RAMS.

[21940.]—It seems almost impossible to carry further the discussion, as Mr. Davies holds such curious opinions on the subjects of weight, momentum, and such like; but I will endeavour to reply to his last letter as best I can under the circumstances. The effect of using a long supply pipe is mainly this: If we have a vertical pipe 6ft. high, and a similar one inclined at an angle of, say, 45°, the latter pipe will contain, roughly speaking, 50 per cent. more water than the former. Now, the dead pressure per square inch will be alike in both cases; but in the longer pipe there is a greater body of water to resist regurgitation when the valve closes, and thus there is more sent up into the rising main. It is, however, the height from which the water descends which determines the height to which the water can be raised, and I presume Mr. Davies will admit that if there were no fall (however great the length) in the supply pipe, there would be no action of the ram. Mr. Davies appears to refer to momentum as something by itself, instead of merely as the product of weight and velocity—a distinction I fail to understand.

A. S. L.

THE THEORY AND CONSTRUCTION OF THE HELIOSTAT.—IV.

[21941.]—The polar axis being now complete, the sun-pointer may be constructed. In Fig. 2, p. 108, *a c* is a piece of steel rod driven tightly through a small barrel-shaped piece of brass at *c*, turning on centres formed by little screws tapped into the two holes in the rectangle at *c*, the same two holes spoken of while describing the adjustment at the end of the last paper. At *a*, Fig. 2, is shown a little fork fitted on the end of the sun-pointer, holding a little barrel between its prongs, which is bored transversely, with a hole just large enough to allow the mirror-tail to pass easily through it. This fork can turn freely round the sun-pointer; but is prevented from sliding along it either by little nuts screwed (or tightly driven) above and below it; or more simply by tapping a small screw through its shank, the point of which lies in a groove turned in the steel rod. The attachment to set the sun-pointer at any desired angle with the polar axis requires no explanation, but can be seen at once from the figure. The adjustment of the sun-pointer will be much facilitated by fixing either to the steel-rod, or, better, to the clamping-piece, a couple of small sights, the one a little piece of brass with a small hole through it, the other a small circular piece of ivory (a common card-counter). If these are properly fixed with their centres equally distant from the steel rod, when the light of the sun passes through the small hole and falls on the centre of the ivory disc, the rod will point accurately at the sun. The sun pointer should be carefully counterpoised by a weight at its lower end.

Fig. 3 represents a piece of brass which must now be constructed. A and B are two screws forming centres by which the piece (Fig. 3) can turn about the holes in the two pieces *A a′*, Fig. 1, p. 108, on the movable ring. The fork C D E, Fig. 3, is tightly fixed to a steel axis which can turn easily in the end *c* of the piece A B C. It is prevented from moving endways by the same device mentioned in connection with the piece *a*, Fig. 2. The hole in the piece A B C, Fig. 3, within which the axis of this fork turns should be carefully drilled, so that the axis, if prolonged, would pass exactly through the middle point of the line A B. A piece of wire about 3in. long should be tapped along its whole length, and hung to a pivot under the end *c* of the piece A B C. A nut tapped to run up and down this wire and resting on a piece fastened to the edge of the "movable circle" will then give the means of accurately setting the piece A B C at any desired elevation.

If we suppose the centres A B and D E respectively, to be joined by imaginary lines, the distance between the bisecting points of these lines must be exactly equal to the length of the sun-pointer measured from the centre on which it turns, to the centre of the little barrel at its extremity destined to embrace the mirror-tail.

The construction of the mirror and its mounting will be evident from an inspection of Fig. 4. It should be carefully counterpoised by the piece D, Fig. 4, so that when it is set so that the points (B C, Fig. 4) turn around the centres D E, Fig. 3, it may balance in any position.

The heliostat proper is now complete: it only remains to connect it with the clock. For this purpose it must be mounted on three pieces of brass rod tapped at their upper ends into the fixed ring, Fig. 1, and at their lower ends into a triangular plate of brass with levelling screws at the corners. The smaller of the two bevel wheels having been driven tight over the axle of the hour-hand of an American clock, the clock must be fixed to the triangular base-plate, so that the bevel wheels are in gear. The arrangement is shown in Fig. 5, p. 108, which gives a view of the whole instrument.

In Fig. 5 the instrument is shown standing upon a small wooden table. This is for the double purpose of affording space for the pendulum to swing, and of holding a small theodolite compass, as shown in Fig. 5. It is better to attach the compass to the wooden table, as its indications can then be read before the heliostat is placed on the table; and so will not be vitiated by the magnetism of the steel rods. A small circular level attached to the base-plate with three tapped wires with jam-nuts, completes the instrument.

To put the heliostat in adjustment, the following method (though only approximative) will be found accurate enough:—

Place the instrument upon its table, so that the levelling screws fit into countersunk holes made for their reception. Choose a bright starlight night. Remove the polar axis from its bearings, and adjust the position of the instrument until the polar star can be seen centrally through the holes in which the polar axis works. Now screw up the level until the bubble is in its centre, and lift off the instrument. As soon as the compass has come to rest, mark the direction in which it points "Magnetic North."

This having been done once for all, and the clock being in good order, all that is necessary, when the instrument is to be used, is to place the wooden table outside a window, so that the compass-needle lies on the mark, then to place the instrument with the levelling screws in their holes, and to turn them until the bubble is in the centre of the level, then to bring the sun-pointer so that the shadow of the far sight comes on the centre of the ivory disc, and to clamp it in this position; then to turn the movable ring and elevate the mirror until the reflected ray takes the desired direction. This direction it should retain very approximately as long as required.

A. T. Hare.

ELECTRIC LAUNCHES.

[21942.]—I have read with much interest the communications that have appeared in "ours" a few weeks ago upon "Electric Launches" (especially the articles quoted from a contemporary by our esteemed friend Nun. Dor.) with the hope of gaining some valuable knowledge therefrom; but hitherto the articles on the subject have consisted rather of dogma and controversy than real information based on experience.

However intrinsically useful secondary batteries may be, the use of them is impossible pending the erection of frequent charging stations, and as the establishment of these (owing to expense and other reasons) seems generally acknowledged as being so far distant as to be outside practical consideration, we are forced to fall back on primary batteries if we are to utilise electricity for propelling launches at all. The great disadvantage of this system has been considered to be the extravagant consumption of zinc in proportion to the energy obtained, but Mr. Toynbee's experiments appear to have shown that with proper apparatus this is not such a drawback as is generally supposed. The matter is one of such public interest that surely some of the scientific and practical correspondents of "ours" could, if they chose, contribute valuable information which would be of immense service to those readers who are interested in the subject.

I have come to the conclusion, after considerable experience of the application of electricity to motive power, that a great, if not the greatest, element of success is the employment of a motor which shall transmit to the propeller shaft a larger proportion of the electrical energy of the battery than any I have met with yet. To obtain accurate results from any experiment in this direction with primary batteries, with a view to obtain economy of maintenance, very little energy must be lost between the battery and the propeller.

Edward Conry.

40, Stanmer-street, Battersea Park-road, S.W.

SPRING MOTOR FOR TRICYCLES.

[21943.]—In answer to "R. B. W." (letter 21914), who draws my attention to what he very rightly considers a defect in my scheme of a spring motor for tricycles, which appeared some weeks ago in the English Mechanic, I beg to state that the sketch was only a rough one, and was published in hopes that some competent judge might be induced to give his opinion on the main point—viz., whether it would be possible to have a spring sufficiently light, powerful, and long, without being too cumbrous. This I myself rather doubt; but as I have had little or no experience in the matter of spring power, I simply sent the sketch, hoping that some person who had would express an opinion. If it were proved that a gain of power might be derived from such a scheme, then one might apply with interest a little more thought to the construction of details.

The first defect which "R. B. W." points out is, in itself, not so bad as he imagines; but it points to another, and, in my opinion, a worse one—viz., the variableness of the power which would be required in winding the spring. With any spring of sufficient strength to be of any practical use, the greatly increased resistance to propulsion before the spring was actually wound—even in descending the steepest hills—would instantly warn the rider to throw it out of gear. This could be done automatically I have no doubt, or the smash which "R. B. W." fears might be avoided in other ways; but as it would imply more mechanism in any case, if possible one ought to avoid it.

With regard to the other matter—viz., gearing, when the spring is wound, without stopping, if "R. B. W." will examine the sketch, he will see (with a stretch of imagination) that one of the small bevel wheels is intended to revolve upon a ratchet, so that when it is geared to the large bevel wheel (to which the spring barrel is attached), if the large wheel still remains fixed (which it would do until the handle K were raised so that the key F was clear of the key way, and the pin which fixes the barrel withdrawn by the crank *x* being turned round) the result would be that the small wheel would cease to revolve; but the ratchet (which, of course, slides on the key of the axle, along with the other small wheel of which it is part) would continue to revolve; when the spring has unwound itself, the two wheels will again stop until the whole are thrown out of gear.

K. M.

NOTES ON THE CONSTRUCTION AND USE OF THE VOSS ELECTRICAL MACHINE.

[21944.]—An interesting and genuine description of the Voss machine has already appeared (English Mechanic, Vol. XXXVI., pages 285 and 329), by our able contributor, Mr. J. T. Sprague. A detailed description of the machine here would, therefore, be merely a repetition of what has already been done. Having recently constructed one of these famous machines, with some slight modifications, which in performance has more than verified my expectations. The following notes, with the appended experiments, may be of use to those interested:—

The Revolving Disc.—This is of glass, one-tenth of an inch in thickness and 20in. in diameter. It is mounted on a wooden cylinder, 5in. by 3in., through the centre of which a hole is bored, and brass bearings are fitted in each end. The cylinder is turned down five-eighths of an inch at one end to receive the glass disc, which is there secured by a
screw collar. A V-shaped groove is
the other end of cylinder for the cord
wheel to work in. The cylinder
secured on its iron axle by a
which, and the end of
carrying the discharg
The metallic discs
in diameter. They
used for lining pa
metallic buttons
take a joiner's
"bit." Place the
wood, and work
ended bit; after a
hemispherical cav
serves in place of

used. Before cementing to the varnished glass disc, the zinc circles were wheeled along between the thumb and finger in a shallow tin trough containing some thick shellac varnish. This treatment produces an insulating covering for the edges, and will also serve to cement them on by.

The two inductors are of sheet zinc, and are segment-shaped, with strips attached, to which the curved arms carrying contact brushes are soldered. Each segment, with the inducing paper, is cemented to a separate rectangular glass plate 22in. by 8in.; and a piece of thin glass is cemented over each inducing paper, just leaving the arm carrying contact brush out. It is necessary that an insulating cement should be used for these plates, and unfortunately the best cements for the purpose have to be used hot, which is liable to crack the glass. The following method will perhaps be found best:—Obtain some sheet guttapercha. Cut this into long strips and, after warming them, lay them round the outer edge of the inducing paper, leaving a short interval at the arm. Now lay the thin glass over all, and place the plates on a flat board in a warm oven for a few minutes, when, the gutta softening, will allow the plates to be pressed close together, and when cool they will be effectually cemented.

The glass plates carrying inductors are held at the bottom between two wooden rods glued to the baseboard, and are steadied above by an ebonite ⊣ piece, the end of which is secured to the wooden support carrying axis of machine. The side on which the thin glass is cemented should be kept as near as possible—without touching—the revolving disc.

The knobs holding the collecting combs and discharging rods are mounted on varnished glass supports. This plan was suggested by Mr. Sprague, and is much better than mounting them on cylindrical Leyden jars, as the electricity from the machine can be used either direct or through movable condensers.

Some consideration is necessary in the choice of condensers. The Leyden jar pattern is generally assumed to be best; but in these there is a considerable loss by the electricity passing between the inner and outer coatings, especially in damp weather. I have, therefore, tried another pattern, which is as follows:—Cut three pieces of window-glass 6in. by 3in. To one of these, after varnishing, attach two pieces of tinfoil 5in. by 2in., one on each side, leaving a margin of half an inch of uncovered glass all round the foils. A loop of copper wire is next placed in contact with one foil at one end, and a similar loop is connected with the opposite foil at the other end. Next cement one of the other glasses, as described above, one each side, and the condenser should appear as in Fig. 1. The thickness of glass used in these condensers should depend on (1) the size of the machine for which they are intended, and (2) on the extent of coated surface. As the electricity is much better separated than in the jar form, a greater charge may be accumulated; consequently, this will require thicker glass to sustain it. With the machine described, I have three pairs of condensers which vary in extent of coated surface from 3in. to 10in., and 60in. super.; with middle glasses $\frac{1}{12}$in., $\frac{1}{10}$in., and $\frac{3}{16}$in. in thickness. And notwithstanding this apparently excessive thickness, the effect of one of the condensers, when carefully compared with that of a Leyden jar of equal coated surface, was much superior. Note that the ends of all foils in the above condensers should be round, so as to avoid sharp corners. In the first condensers which I made on the principle, the foils had corners; and once when in use on the machine, the electricity broke through the glass of each condenser at the corners, with a sharp report. This has not occurred since using the thick glass and foils without corners.

Two of the above condensers are required for use in the machine. When used for the spark discharge, they are hung by the wire loops on the discharging rods; and the lower ends are connected together by a stout copper wire, on each end of which a bullet has been cast. This, when not so used, will serve as a discharging rod for Leyden jars.

All the contact brushes in the machine are made of the flexible gilt cord used for conductors in medical machines. And all parts of the machine,
quired to conduct electricity, are well covered
arnish made by dissolving 2oz. of shellac in
methylated spirit.
xpected from the foregoing descrip-
described is a very efficient one,
der very unfavourable conditions
re. As an example, I have fre-
a room without a fire, when
icity produced has predomi-
alling on an iron roof.
the discharge between
rs) is from 6in. to
us stream, having
ing the con-

produce a ringing sensation in the ears. On bringing the terminal knobs closer together the discharge again assumes the appearance of a continuous stream.

The machine is, of course, self-charging; but it sometimes requires to be worked for a few minutes before it will act in damp weather. There is also a peculiarity in the action when the machine is worked in a very damp atmosphere—viz., the discharge, instead of being constant, frequently changes in polarity. I have often counted the number of revolutions of the driving wheel between these changes, and they appear to occur at regular intervals; the time of interval being according to the state of atmosphere. In damp air the changes have been as often as once in every 30 revolutions of the disc, whilst in dry weather the change may not occur many times during an hour's work.

Several writers have called attention to these changes; but I am not aware of any explanation given. From the fact that they are not accompanied by any sudden discharge, I am inclined to think that the peculiarity is a necessary function in the action of the machine. When the alteration of polarity does occur, it may be beautifully indicated if we hold a square piece of thin metal (insulated) between the knobs of machine. The discharge will then appear like two horns at the corners of metal at one side; whilst the "glow" is produced at the other corners. This appearance will be reversed with the alteration in direction of current, Fig. 2.

Fig. 1.

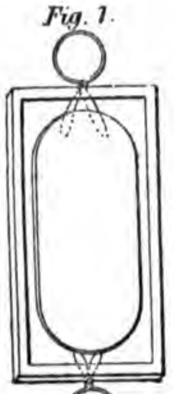
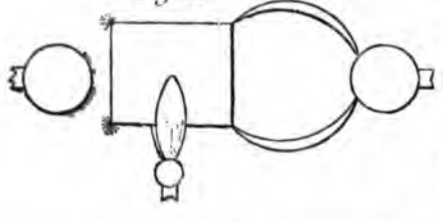


Fig. 2.



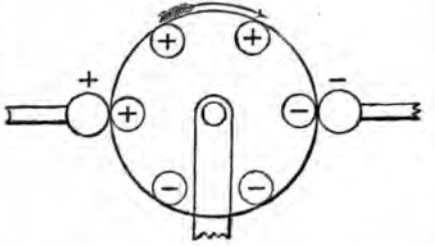
Having thus given a brief notice of some of the essential points in the construction of the machine, I will next mention some of the applications of the machine.

(1) *Physiological Effects.*—If electricity is required for medical purposes, then the Voss machine is capable of supplying it from an effect scarcely perceptible to a discharge which is unbearable. To use the machine for medical purposes, the condensers should be hung on the discharging rods and conductors attached to their lower ends. The discharging knobs should then be brought together, then, by working the machine, and gradually separating the knobs, the effect from the conductors may be increased to the required extent.

(2) *Luminous Effects.*—Beautiful effects may be produced by allowing the discharge from the machine to pass through vacuum tubes, brass chain, designs formed by pasting small pieces of tinfoil on glass, &c. The old and familiar "electrical whirl" is capable of affording a beautiful experiment when used in connection with the Voss machine. I mean the luminous appearance visible when the whirl is worked in the dark. If a whirl is mounted on an insulated axis, formed by driving a pin into the end of a rod of gutterpurcha; then, on bringing the head of pin into contact with one of the knobs of the machine when in action, the whirl will of course revolve rapidly. If it is then seen in darkness, the points of the whirl will appear to form a luminous circle; but on gradually withdrawing the head pin from the knob, so that a short spark passes, then the luminous circle will appear to break up into one of little stars, with *beautiful scintillations.* The effect will also differ with the terminal to which the whirl is held. This experiment illustrates the fact that the discharge from the Voss machine, although appearing as though a continuous stream of electricity, is really composed of a series of separate sparks which follow each other with rapidity. The extraordinary appearance of the metallic discs of the machine when in motion has been shown by Mr. Sprague to be due to the same cause.

(8) *Mechanical Effects.* — Like the dynamo machine in current electricity, the Voss machine is not only well-adapted for the conversion of of mechanical force into electricity, but *vice versâ*; a model constructed on a similar principle is, probably, the best means of converting static electricity into mechanical force. This may be experimentally demonstrated by constructing a small model, by cementing some little circles of paper or tinfoil round a disc of thin ebonite or guttapercha. This, when mounted on an insulated support, and placed between the discharging rods of the machine when in action, will revolve with extreme rapidity (Fig. 3.) The cause of the motion is obviously due to attraction and repulsion. The little discs in the model are not so well under that influence as in their normal position in the machine; but the effect is quite sufficient for a lecture or class experiment. Here, then, we have a static electromotor; and insignificant as the power of such may seem, it is not so, when we consider the small expenditure of mechanical force required to produce the electricity in the machine.

Fig. 3.



In conclusion, I may say that the theory of the Voss machine is simple to those conversant with the rudiments of electrical science; but that which has probably confused most amateurs, is the position of the secondary, or discharging comb, as represented in the several illustrations of the machine which have appeared. The secondary combs should, with their metallic brushes, touch the metallic discs whilst still under the influence of the inducing papers. **Frederick Cowle.**

AMATEUR WIND INSTRUMENT MAKING.

[21945.]—This subject has not received the attention it deserves from amateurs, probably for some of the following reasons:—To produce good results it requires mechanical skill in working both wood and metal, a musical knowledge of, and ability to play, the instrument, without which one cannot tune properly. Good players become accustomed to an instrument, and unconsciously hide its defects; therefore, if playing on a strange instrument, they seldom play as well in tune as their own, yet both instruments would be quite correct with their accustomed players. The difficulty of procuring tools and appliances, of which the number is considerable, is another element: most makers produce their own to suit their requirements, and last, the absence of published works giving sufficient details and explanations. Yet there is no reason why this branch of amateur art should not be as popular as others that have less to show of real value for the time expended on their construction. The following instruments can be made by amateurs, as they do not require any very expensive plant or tools:—Clarionets, flutes, oboes, bassoons, bass clarionets, corni-di-basseto, and cor-anglais. For the present, however, we will confine our attention to the clarionet, as being the easiest to make for a variety of reasons. Clarionets are used in a great variety of keys or pitches, the most usual being A natural, B flat, C natural, E flat, &c. The instrument consists of a parallel tube, ending in a conical bell, the sound vibrations being produced by a beating reed, made of cane, attached by a ligature to a mouthpiece. The entire instrument, excepting keys, &c., is usually made of cocus wood, and although sometimes brass or ebonite clarionets are used, yet the general opinion is that cocus wood or ebony produces the finest tone. Clarionets have a legitimate range of three octaves, though another octave can be got by skilful blowing; it is difficult to control, and not used except in solo music as an effect. Two qualities of tone are produced by this instrument, the lower 11 notes are called "chalumeau," those above this are "clarion," or the true clarionet tones. "Chalumeau" notes are a little like the bassoon, and have no resemblance to "clarion," although the latter is produced from the fingering of the former by slightly reducing the pressure of air and opening a key, which raises all the scale one twelfth. The following is an outline of the clarionet I propose to describe: "An English pitch, Albert Model Clarionet," with 13 keys, 2 rings on lower joints, and patent C sharp arrangement; made in three pieces, viz., mouthpiece, body, and bell, omitting the barrel and middle socket. This enables the low C sharp to be properly placed.

With regard to the mouthpiece, it is best to purchase it, for many reasons, principally because if one tunes a clarionet to a mouthpiece having any slight defect or peculiarity, it may be impossible to correct it afterwards. A mouthpiece, reed, and ligature cost from 3s. to 10s., according to the care bestowed on it by the maker, and also the material it is made of, as to which there is great difference of opinion. As a rule, however, those of ebony are quite as good as any other material. Those made of metal or of glass have now been generally condemned as unsuitable. I may as wel state here that I intend to give the measurement in centimetres and millimetres, as the relationshi between parts is easier seen than by using inch and eighths, and calculations are easier made in t measure. Also I intend to select the easiest wa of construction, excluding tools that are specialiti Those who desire to make a mouthpiece may p ceed as follows: A good hard piece of co ebony is chosen, 4½in. long, and fully 1¼in. A hole is then bored nearly up to C. a ½in. Morse twist drill running in the wood may be first roughly t slight taper, then driven into a ch

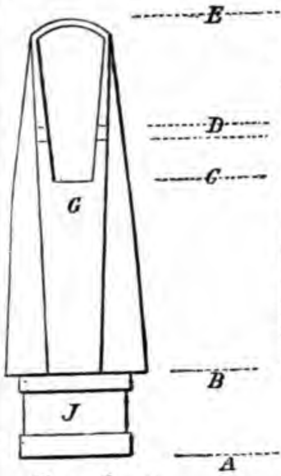


Fig. 2.

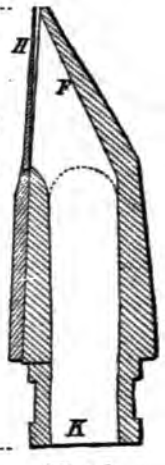


Fig. 1.

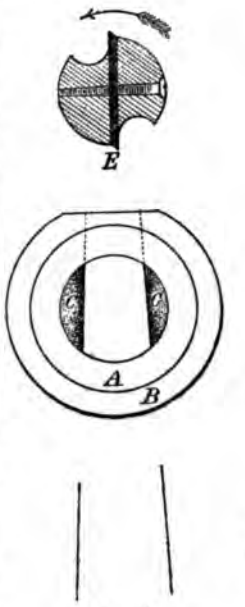


Fig. 3.

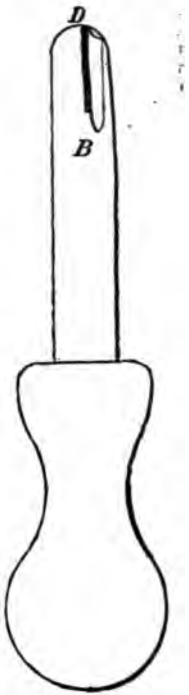


Fig. 4.

foot foremost" between stations, to make up for these delays. It is true they are nominally prohibited from "making up lost time by increased speed," but somehow they usually manage to come in to the minute, even if there has been considerable loss of time *en route*. To accomplish this it is necessary to run at from 40 to 50 miles an hour in places, and this is done without danger or inconvenience. Each carriage is on two bogies, the engine and tender on *four*, so there is surprising smoothness and steadiness even in the worst parts of the road. The American express engines (classes K and Q) work the expresses very satisfactorily, so long as the trains do not exceed seven or eight coaches. I have known an engine of the K class (K 94), keep time on the good part of the road with 12 coaches, the gradient generally being slightly favourable. And I have seen one of the Q class (which differ from K in having cylinders 11 by 18, instead of 12 by 20, both having 4ft. wheels, four coupled), with nine coaches, gain seven minutes on the run of 27¾ miles from Studholme Junction to Oamaru, which was done in exactly an hour, the ruling gradient being 1 in 100, and the maximum speed 48 miles an hour down the banks as against 20 ascending. But, on the other hand, I have several times noticed the more powerful K's having to take a pilot with 10 coaches on a heavy road; and once even on the easy stretch from Christchurch to Rakaia, which has generally rising gradients, but none steeper than 1 in 200, and no curves. That run, however, was timed much faster than the ordinary rate, an average speed of nearly 35 miles an hour having to be maintained, with frequent stops; and I may add that time was equally well kept at a like speed on the same piece of line, and by the same two engines (K 87 and K 88), with 15 crowded coaches. For light express work these engines could hardly be improved; and it is noteworthy that during the past year the eight engines of class K (Nos. 87, 88, 92, 93, 94, 95, 96, 97,) have averaged 34,308 miles a piece, at a total cost of from 0·103d. to 0·111d. per ton-mile; while the two of class Q (Nos. 17 and 51) have averaged 26,377 miles each, at a cost of 0·103d. per ton-mile.

Nevertheless, I must confess myself still unconverted as to the need of sending to America for these engines at a materially increased cost; because it seems to me that either the English "Moguls" (Class J), built by Messrs. Dübs and Co., Neilson and Co., Stephenson and Co., and by the late Avonside Company, or the single-boiler Fairlies, are capable of doing all that is required in the way of speed, while able to pull a greatly superior load. In my last letter, I quoted some notes made by myself on the working of these engines with express trains, and as showing that an almost equally good average speed was maintained as by the American express engines, if a lower maximum was reached. I have several times seen both of these classes working the expresses; and while they kept time just as well as the regular express engines on light trains, they ran with equal punctuality on trains greatly heavier than the K or Q class could have hauled at all in time. For instance, J 107 and J 108 (Dübs), and J 117 (Neilson), kept time strictly on the express with 12 coaches on a heavy road; and J 83 maintained an average rate of 30 miles an hour for 15 miles, including starting and stopping, with no fewer than 20 coaches, the maximum speed being 40. The work of the single Fairlies has already been adverted to. I believe these two classes, with perhaps one lighter type for shunting and branch traffic, would meet all our present requirements; but instead of these three classes we have 23—20 too many. I am strongly persuaded, too, that the double Fairlies have never been quite "fairly" treated in this country. They were worked under distinct disadvantages, with inadequate loads, and then abused for costliness. When they might have been tested with full loads, they were ignominiously relegated to shunting and branch traffic. When engines of special haulage power and flexibility were required for the goods traffic on the heavy grades and sharp curves of the Dunedin—Oamaru section, recourse was had to the American "Consolidation" engines, which to eight coupled wheels add ten more, carrying the pony truck and the double-bogie tender. I am convinced that the twelve-wheeled double Fairlies, double six coupled, with similar tractive force, would have been much more suitable and profitable. They would have utilised their entire weight for adhesion, and would have carried ample fuel and water for the comparatively short runs. But there is undeniably a prejudice against these engines, and so they have never had a really fair trial out here.

Our latest locomotive importations are the heavier single-boiler Fairlies, weighing 32 tons instead of 29, and with 13in. cylinders instead of 12in. These are doing capital work. An order is also under execution in England of additional "Moguls" (Class J), which will differ from the others of their class only in being without flanges on the driving wheels, after the style of the "Consolidation" engines. So far as I can learn, it is intended in future to confine orders to classes D, F, J, and R (see Vol. XXXIII. p. 64), these having proved the most useful types, and capable of performing the utmost variety of work involved in our service as at present carried on, and as likely to be conducted during the next few years.

Reverting for a moment to the double Fairlie engines, and carrying out my previous practice of giving *both* sides of the case as impartially as possible, I think it worth while to quote the remarks of a friend who was formerly in the loco. department on one of our N.Z. railways, and had experience with three of the double Fairlies. He writes:—"In a reply to you (in the English Mechanic, Vol. XXX. p. 118), Mr. Robert Fairlie gave some very low figures as the cost of repairs to his engines, and it at once struck me, on reading them, that he had in mistake treated the two ends of the engines as separate locomotives. Now the Fairlie engines had each *two* numbers (the makers'), and of those which I had to do with one was numbered 1066 at one end and 1067 at the other; the second was numbered 1068 and 1069, and the third 1070 and 1071. At the time of which I am writing they had no other distinguishing, so that a fitter, for instance, in giving in his time would put it something like this:—"Connecting-rod brasses, No. 1071, 4 hours; new piston rings, No. 1070, 4 hours, &c." And so it would appear in the books that the man had been working at *two* engines instead of *one*. I have no doubt that the double Fairlie shows at its best on a line like the Wanganui section, with gradients of 1 in 38 both ways; but on a more favourable line, the single-boiler engine is in every respect more economical." These observations are interesting as coming from a thoroughly practical man, wholly unbiassed. I cannot, however, state, of my own personal knowledge, whether the favourable figures quoted by Mr. Fairlie were or were not based on these somewhat misleading data. Individually I am disposed to believe that the double Fairlies will compare satisfactorily with *any* engine under the conditions stipulated by their inventor—that is to say, full loads and proper expansive working.

I fear my letter is exceeding due limits: my excuse must be the engineering interest of the subject. Our N. Z. experiences are those of a practically new national system of narrow gauge, cheap construction and light rails, steep gradients and sharp curves, with engines specially built—some experimentally—to suit the special characteristics of the road. I feel sure that the results will not fail to be interesting to many readers at home. I may just mention in conclusion that at the close of the last official year (March 31st) we had 1,370 miles of Government railways open, in addition to some 84 miles of private line. The total cost of the Government railways was £10,478,000; the gross receipts for last year £953,000, of which working expenses absorbed 62 per cent., leaving £360,526 as net profit, equal to 3½ per cent. on construction cost. The completed main trunk line of the South Island paid 4⅛ per cent. During the year the N. Z. railways carried 3,283,378 passenger; 1,564,793 tons of goods; 341,186 parcels, horses and dogs; 477,075 sheep, cattle, and pigs. Not a bad result for a population of only just half a million. As to locomotive work, on the South Island Main Line (Hurunui—Bluff), 848 miles, 118 engines ran 2,520,744 engine-miles, at a cost of 9·05d. per engine-mile; and hauled 155,378,070 tons, at a cost of 0·105d. per ton-mile; the 118 engines being 25,294 days in steam.

Charles Rous Marten, F.R.G.S.

Wellington, New Zealand, July 20.

THE PARKER-SMITH BRAKE—TO "IMPRIMATUR."

[21949.]—Having been an *impartial* contributor to the English Mechanic for nearly thirteen years, it is quite unnecessary for me to take any notice of the personalities which have been imported into this correspondence; it should, however, be mentioned that the sole reason why I am *unfavourably inclined to mechanical brakes* is that during the past fourteen years I have had ample opportunities of examining them and seeing their defects in actual practice.

Your correspondent, page 132, devotes the greater part of his letter to an attempt to find fault with air, vacuum, and Heberlein brakes, and some of his statements are very incorrect; but what has this to do with the present correspondence? Even if all the statements of "Imprimatur" were correct, it would not alter the fact that in the Board of Trade Return the Parker-Smith brake is stated not to fulfil the necessary conditions. Several objections have been raised by engineers to the Parker-Smith system. "Imprimatur" claims that the brake is always on, and that a train cannot start till it is taken "off." In practice, however, it would be necessary to have some means provided to keep the brake out of action during shunting operations, and of course there would be the risk that when the train was made up the servants might forget to couple the brake-chain.

There is a great defect in all systems which are applied by the slackening of a chain or wire rope. In *theory* it is supposed that the instant the chain is released the brake will be simultaneously applied, but in *practice* this is not the case; rust and dirt very soon cause the pulleys to work badly and the chain to stick; in winter-time snow and ice frequently render brake-chains and communication cords perfectly useless.

In cases of breaking loose, it is necessary that the brake couplings between the vehicles should part without injury, so that when again connected the brake may be in working order. Now, suppose a Parker-Smith train divided, what would be the result? The chain would be broken, and possibly a portion of it pulled away from under the vehicles.

I was unable to accept the invitation of the Institution of Mechanical Engineers to attend and take part in the discussion upon the Parker-Smith brake last November. Had I been able to do so, it was my intention to have asked for information upon these and other points.

It may be well to mention that many automatic mechanical brakes have been invented, tried, and afterwards removed on account of inefficiency. For instance, in 1869—70, I was invited by Messrs. Wilkin and Clarke to attend trials of their improved system on the Metropolitan and Midland Railways. The retarding force was mechanically developed from one axle on each carriage, and the brake was kept "off" by tightening a chain and applied by slackening it. About five years ago I saw a train on the London and North-Western Railway fitted with a very similar apparatus, but a steel-wire rope was used in place of a chain. In the Parker-Smith system a screw is employed instead of a friction wheel or other appliance, but the principle remains the same.

Mr. Parker-Smith in his paper, and "Imprimatur" in his letter, express the opinion that the "simplest means of securing a result is the best." This may be very true *if the result is secured;* but I cannot for a moment think that the *efficiency* of a brake ought to be sacrificed to so-called *simplicity*.

A continuous brake is a life-saving apparatus, and therefore the great point is *efficiency*. If the only thing wanted was a *simple brake*, surely that can be obtained at once. The old lever brake on coal waggons or the hand screw in guards' vans are as *simple* at possible.

In conclusion, I still maintain that mechanical brakes have had their day, and must now give place to better inventions, but if your correspondent can bring forward any *facts* to disprove this opinion; I shall be happy to consider them.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Oct. 15.

WHAT IS THE BEST OIL LIGHT FOR THE MAGIC LANTERN?

[21950.]—During the winter months I am often occupied in giving popular scientific lectures in the country, and I find the magic lantern most useful in illustrating these lectures; the movable slides in my astronomical lectures seem to be highly appreciated, for the fact is still the same—

> "Segnius irritant animos demissa per aurem
> Quam quæ sunt oculis subjecta fidelibus,"

that is, "seeing is believing."

There is no doubt that for exhibiting pictures on the screen the oxyhydrogen light is by far the best, next comes the oxycalcium; but in both these cases bags of gas are necessary, which in the country are both a trouble to fill, and a nuisance to carry about; but the petroleum and paraffin oils now afford a safe and useful means of illumination. The question is, are we now getting all the light from them that is possible?

We have in the market, two, three, and four-wick lanterns, the light of which is infinitely better than the old sperm oil lamp; but yet I think that possibly if some of those of your contributors who make "lantern optics" their *spécialité*, would give their attention to the matter, the light obtained from these oils might still be improved.

I have been lately using a lantern with four wicks, the light of which is better than any I have had before; but it claims "to give the light of 200 candles," which, as every scientific man knows, is utterly ridiculous.

The puffing advertisements of the "shoptician" do much harm to real science, and in asking for a discussion on the following subjects (as the lantern season has now returned), I should like, with your kind permission, to keep the "shop" out of it.

1. Which is the best of the petroleum or [illegible] oils for use with the magic lantern?

2. What form of lamp, and what wicks, the width of the wick also bein gives the best light in both quantity whiteness of light, and perfect com brought into account?

3. What amount of light in sta really given by the very best oil li able circumstances?

4. In arranging distance of li according to the principle of

source of light is considered as a *point*: how does the fact of the oil light covering a large area affect this?

5. In a lantern with 4in. condensers, is not much light lost by the usual circular slides of 3in. diameter being placed too close to the condenser? Is it not advisable that there should be a means of placing the slide at such a distance from the condensers that all the cone of rays from condenser should pass through it? In square slides this is not necessary. **Rector, F.R.A.S.**

THE BERTHON POWER GAUGE.

[21951.]—It is very desirable that those who use astronomical telescopes should have a ready and accurate means of determining the powers of their eyepieces. Berthon's power gauge is excellent in principle, but my experience of the working of those which have come under my own notice is far from satisfactory.

As I was anxious to know how my 8½in. Calver would stand a very high power, I asked an astronomical friend, who had recently become possessed of an eyepiece which he told me he had measured with his Berthon power gauge and had found to magnify about 830 on a mirror of 6½ft. focus, to lend it to me. This he kindly did, and my mirror, in a good state of the atmosphere, bore it admirably on the moon, δ Cygni, ε, and ε₂ Lyræ, and other objects which I tried. But I thought it did not appear to magnify anything like twice as much as my own highest power, which my Berthon power gauge made 450. So I measured it carefully and found that its power, according to my gauge, was 530. I reported this to the owner. He, fancying that the great difference might be due to some "personal equation," asked me to try *his* power gauge, which he sent me. My result with this agreed closely with his own. Evidently the difference was due to inaccuracy in one or both of the gauges. By placing pieces of wire between the jaws of the slit and noticing the measures of the diameters as given by the two gauges, I found that the results were very different. I next sent the two gauges to my friend; he borrowed a third, and also a Birmingham wire gauge, and found that none of the three power gauges agreed, as the following table of a few corresponding measures will show:—

Gauge A.	Gauge B.	Gauge C.
·200	·188	·188
·100	·104	·094
·120	·026	·014

Gauge A, which was supplied by Horne and Thornthwaite, agreed most closely with the B.W.G.; gauge B I procured of Tuck, of Romsey; gauge C is marked J. T., and was said when purchased to be by Tuck.

Would any correspondent compare his gauge with that of some friend, and see if he finds them agree or not. A gauge to be of use should be correct. Persons possessing gauges which underrate powers would naturally blame their telescopes for not bearing certain powers so well as they should do; and also might accuse the maker of eyepieces of not sending the powers ordered.

T. Perkins, M.A., Shaftesbury.

THE SUEZ AND SIMILAR CANALS.

[21952.]—All are but anticipation of the work of time. Man's agency will but hurry forward that which must come. The ceaseless action of the waves wears away the land in one place to add to it in another. By reference to the map of America, it will be seen at a glance, the approach of the Pacific and the Atlantic, when they join (the two largest seas in the world), it may make a difference to the whole globe. The Pacific may never be so calm, nor the Atlantic so rough again. The British Channel is but a natural one, formed, in the course of ages, by the action of the waves. The similarity of the opposite soils of Dover and Calais, proving, in the opinion of geologists, that they once joined. What change that natural canal has caused to our island history will prove.

H. F.

Product of the Hen.—The hen has in her ovaries, in round numbers, more than 600 egg germs, which develop gradually and are successfully laid. Of these 600 the hen will lay 20 in her first year; 135 in her second, and 114 in the third. In each one of the following four years the number of eggs will be diminished by 20, and in her ninth year she will lay at most 10. In order to obtain from [illegible] the [illegible]

REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51203.]—**Music.**—By the reply to the querist "G. F. H." given by Mr. Wm. Jn. Grey, I presume he (Mr. Grey) is unacquainted with the science of acoustics, for it is evident that he does not understand the proper use of mutation stops in organs. Mr. Grey says:—"When we play full to fifteenth, the principal and fifteenth give consecutive octaves with the foundation stops and with each other; and the twelfth yields consecutive fifths with the principal and consecutive fourths with the fifteenth. All these progressions are forbidden by the rules, but the result of them (the progressions, not the rules) is very good." Mr. Grey then concludes that there must be something wrong about the rules of harmony. Now, to understand the proper use of such stops as the principal, twelfth, fifteenth, &c., it must be known that musical tones or sounds are divided into two classes, simple tones and compound tones; that a compound tone is one which has harmonic upper partials more or less present, and that a simple tone is one which has no upper partials; that very few musical sounds are really simple sounds, the majority having upper partials present with some degree of intensity; even the tone of the human voice is classed as a compound tone. It is the presence or absence, and the intensity, of these upper partials which give different qualities to different sounds, and these upper partials are in the same ratio to the prime tone as the numbers 2 to 1, 3 to 1, 4 to 1, &c. That is, supposing the vibration number of the prime to be 16, that of its first upper partial will be 16 by 2, that of its second 16 by 3, that of its fourth 16 by 4, and so on. In tones where the upper partials are absent—that is, in simple tones—the quality is dull and poor; as, for instance, the tone of a tuning fork. In tones having the first two or three upper partials present, the quality of tone is sharp and full. Where the upper partials, especially the first two or three, are loud in comparison with the prime tone, the quality is nasal and poor. Where the higher upper partials are present largely, as in reed pipes of organs, the tone is crisp, sharp, and cutting. It is to strengthen these harmonic upper partials, and so add brightness to the tone, that mutation stops are introduced into organs. Thus the principal strengthens the first harmonic, the twelfth strengthens the second, the fifteenth the third, and the mixtures according to whatever sounds they produce. Perhaps "G. F. H." will see now that Mr. Wm. Jn. Grey's illustration of the mutation stops producing consecutives is erroneous. It is consecutives between primes that are forbidden.—Wm. Archbutt Taylor. Dundalk.

[51228.]—**Deflection of Girder.**—There seems to be no generally acknowledged formula for finding the deflection of girders, so far as I can find: indeed, I do not remember having seen one for iron. But if "J. F.'s" girders are in wood, the following approximate rule may suit his purpose: Multiply the weight (in cwts.) on girder by the cube of its length in feet, divide this by 54 times the breadth in inches, multiplied by the cube of the depth in inches, and the product will give the deflection in inches.—Engineer, Dewsbury.

[51242.]—**Secretary's Liability** (**U.Q.**)—I am rather surprised at this question being left unanswered by the legal correspondents of "ours," as it fairly belongs to them, and is, moreover, of very general interest. I think that "Ireland" would not be liable for the rent of the room; but it might depend upon the form of the receipt. He should take care to have the name of the society (and not his own) mentioned in all receipts. The receipts so made out are good enough for him as against his auditors, and I am of opinion that no personal liability would be incurred. At the same time I do not profess to speak with certainty on the matter, and would like to hear the views of our legal men.—Wm. John Grey, Hon. Sec., Newcastle Rifle Association, Quayside, Newcastle.

[51249.] — **Killing Mice by Electricity** (**U.Q.**)—If ordinary traps will not do, I think matters would not be improved by trying to use electricity; and as the querist is not an electrician, he might get a shock from the apparatus himself. Some people just now seem to have a mania for using electricity for all sorts of possible and impossible ends.—Wm. John Grey, Quayside, Newcastle.

[51251.]—**Sulphuretted Hydrogen** (**U.Q.**)—There is no better way of making this than by FeS [illegible] SO₄ or HCl; I prefer the latter. If a large [illegible] is needed, use a large quantity of material. [illegible]y manage to avoid the smell.—Wm. [illegible]side, Newcastle.

[illegible]**etted Hydrogen** (**U.Q.**)—[illegible] Nai[illegible]" will find a better or cheaper way of making H_2S than the ordinary one—i.e., by the action of H_2SO_4 on FeS. The gas which escapes from the solution submitted to its action may be conducted by means of a tube into liquid ammonia, or any other absorbent; it might also be burnt, forming SO_2 and H_2O, when the SO_2 would destroy any H_2S in the atmosphere occurring from leakage in the apparatus. Chlorine also instantly decomposes H_2S into HCl and S; it can readily be generated by the action of *strong* HCl on potassium permanganate, heat being unnecessary.—W. E. Haden.

[51253.]—**New Zealand.**—The information supplied by "London Stone" is no doubt cheerfully given, but in every case misleading. He apparently never left Auckland, and then makes the ridiculous statement that "his remarks, applying to the colony as a whole, are founded on experience purchased in Auckland." In the north of Auckland the soil is formed mostly of clay, but of such a quality that it only requires cultivation and drainage, which I believe are sometimes necessary in England. The southern part being in a volcanic district, the soil is not the best to be had; whilst in the region of the Thames Valley, where "L. S." seems to have resided, and principally in the region of the Waikato, the soil is very fertile; in fact, from the mouth of this river down the west coast the country only requires opening up. The rain, it is true, carries off the "soluble salts" from the mountains; but instead of taking them to sea, leaves the most of them on the flat lands at the mouths of the numerous rivers. The following may be interesting:—

In 1881, in N.Z.,	
Wheat under cultivation....	324,933 acres.
Bushels produced	8,147,705.
Bushels per acre............	25·07.
The whole six colonies of Australia—	
Wheat under cultivation....	3,051,151 acres.
Bushels produced	23,421,223.
Bushels per acre............	7·64.

Giving at least 200 per cent. better results to New Zealand. In the same way, 75 per cent. oats; 60 per cent. barley.—*Wellington Chamber of Commerce.* As for cold, during an experience extending over 26 years, snow has never remained for an hour on any part of the north island, except on the mountain ranges. Also, whilst on tour over the whole of that island in 1881, from Jan. to Sept., not ten days rain were experienced. This, however, is not always the rule. The houses in the Thames Valley are very likely to be "rocked," as people there go in mostly for gold, and not for building. The weather in Auckland seems to have completely "enervated" "L. S." Why do tree ferns require such "coddling" when brought to England? This climate is too cold, and their sufferings are very evident. Has "L. S." ever met with the native red pine, used all over the colony for indoor work; also, the yellow pine, the strongest woods in New Zealand? Kauri grows only in Auckland, and not below the region of the Thames Valley, where it forms the principal part of the wooded land. Puriri also only grows in Auckland. Totara is used for building purposes, bridges, wharves, fencing, and sleepers. Fences made of it have lasted for 25 years without decay. Seasoning timber for any length of time is considered unnecessary in N. Z., and accounts for the warping. What do the "thin panels" fail to protect one from? The rabbits have had one peculiar beneficial effect; they induced several runholders to break up their property into small farms, or runs, which are sold to settlers. The thirty lines of print about birds, &c., is mostly contained in the quarter column of extracts, which, however, being in a local paper, refer to that district alone, I infer. The exact locality of the writer is not told by "L. S." Finally, he seriously bemoans the fate of New Zealand in being so "splendidly adapted, &c." Now, being a reflective person, and knowing what carriage costs, I am able to inform "L. S." that a ton of goods can be taken by sea, 15,000 miles (England to N. Z.) whilst the same goods would only be taken 500 miles, or less, by rail for the same amount of money. In support of this, how is it that Australian growers find it pays them to send wheat to England, in competition with America, which is far nearer? I think this shows that "L. S." knows little or nothing about the subject. As is the case with other colonies, N. Z. suffers from the affliction of having all kinds of people sent out; to try and get employment in some cases, in others to be rid of a nuisance. The latter are always known by having a profound contempt for colonials in general, and show their profound ignorance of anything in attempting to run down a country which does nothing for them. Even labourers earn from 5s. to 8s. per diem of eight hours; but being better fed, better paid, and better treated, are expected to work well. Moreover, from the mildness of the climate, and the small proportion of population to land, there is always labour for those who are willing to work. Capital is not a necessity if outfits are brought out, but is useful for land investments, which become more valuable every year, as the Crown land decreases and the land passes into private hands.—Joulad.

[51290.]—**Making Glass Impervious to Steam** (U.Q.)—It is news to me that glass lets steam through. I thought it was used for the boiler gauges of locomotives. Will "Edgar" explain more clearly what he wants?—Wm. John Grey, Quayside, Newcastle.

[51398.]—**Black** (U.Q.)—As no one else attempts to answer this, I beg to submit the following recipes taken from a book entitled "New Facts" in my possession. I send it for what it is worth. "Another process for dyeing black, which also produces good results, is the following:—Prepare a bath containing 1lb. of logwood extract and 5oz. fustic extract, which is sufficient for 10lb. of yarn. The yarn is to be boiled with this compound for about 15 minutes and left to stand overnight, next morning the yarn to be lifted out, wrung, put into a bath containing 4oz. bichromate of potash and 20oz. bluestone and worked therein for about 15 minutes; it is to be lifted out again and wrung. To the above logwood bath 2oz. of crystal soda are to be added, after which the yarn is put in and worked about for half an hour and lifted out and wrung, and again put into the bichromate bath for 15 minutes, to which is previously added 2½oz. copperas. The yarn is to be wrung as before, and, lastly, it is to be returned to the logwood bath, wherein it remains for half an hour. After being well saturated it is to be lifted out, wrung, and dried without washing. To give this black a nice bright finish, it has to be passed once more through the logwood bath, to which has been previously added 1oz. of olive oil mixed with half a quart of water and 1oz. soda ash." The article from which this extract is taken is headed "A bright and very deep Black for Cotton," and another process is given which I abbreviate:—8lb. logwood extract, 1lb. quercitron, boiled for half an hour. In this liquor dissolve 1lb. bluestone. Put yarn in this dye bath while hot, work about for half an hour, then raise temperature of bath to boiling point; let yarn remain in half an hour longer. Prepare second bath: 1lb. bichromate of potash, ¼lb. stone salt; put prepared yarn in this, work well about, and when cool wash yarn well in water. The second bath should look a nice brown colour, and if too black a small quantity of bluestone must be added to it. Bluestone is sulphate of copper.—Codadad.

[51520.]—**Granule Carbon Battery.**—The Grove or Bunsen battery is about the best "Nill" can use to light his window if he must light it with electric light, or he might try a bichromate with Trouvé's solution and very large negative plates; but it will be expensive, whichever battery he uses.—Watt.

[51543.]—**Reversion** (U.Q.)—If querist will state his case more clearly, I will try to reply.—R. Hannen.

[51559.]—**Tonnage of Steamers.**—I am not sure that I understand this query—as to the information required,—and as I mistrust my recollection of the difference between spar-decked and awning-decked vessels, I would point out to the querist that he can see "Lloyd's Register" at the "Jerusalem," or at the office in White Lion Court, Cornhill, or for the matter of that, at any shipping office almost, or marine insurance brokers. A reference to the regulations will give him all the information he requires, whatever that may be.—Nun. Dor.

[51570.]—**Blacking Machinery.**—None is required.—J. M.

[51576.]—**G. E. R. Engines.**—Presumably "Buff" means what are called "Mogul" engines. They have been described in back numbers. These queries about locomotives are really very interesting to about six people; but they take up an awful lot of room, and must, I should imagine, be expensive. Take the cut on p. 131 for instance. Possibly the improvements in engine 611 are something wonderful, but as they are not stated, and the drawing resembles engines I saw on the G. E. line certainly ten years ago, I would ask what purpose is served by Mr. Brewer's sketch. The details that would be useful are missing; it is, however, satisfactory to have Mr. Brewer's assurance that the engines are "very neat and well finished."—N. E. Child.

[51578.]—**Rhinoceros Horn.**—Very doubtful whether the walking stick is made of rhinoceros horn; but horn can be softened by steaming or soaking in boiling water.—N. E. Child.

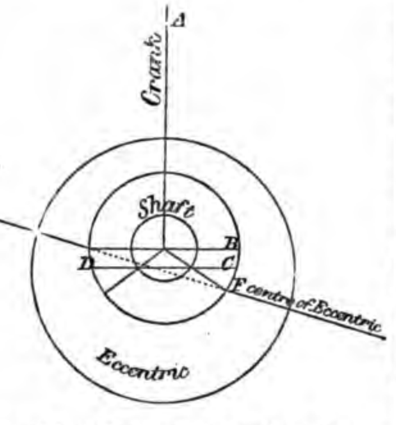
[51584.]—**H. P. of Engine.**—This query is answered in every back volume, and in the text-books and pocketbooks. "Exon" will have to assume a speed, as the number of revolutions is an important item in the calculation. If by "baffle-plate," he means bridge, it is to help heat the gases and prevent them flowing direct into the tubes without combining with oxygen.—Nun. Dor.

[51586.]—**Windmill for Pumping Water.**—What is the difficulty? Connect the pumps direct to the shaft, and make the windmill horizontal or vertical to suit the situation.—Nun. Dor.

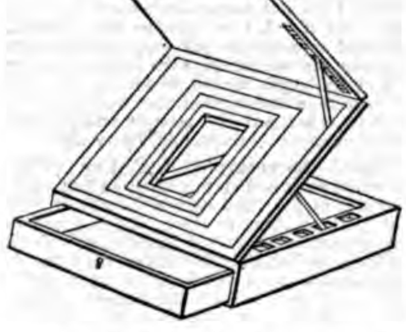
[51594.]—**Crystoleum Painting.**—Look on p. 597, No. 936, and refer to the index of the last volume.—J. M.

[51632.]—**Vaccination.**—"W. M." has omitted to state if his child has been vaccinated with cow-pock virus, or with a scab taken from some kind (?) fellow-being. If vaccinated with the latter, then "W. M." better inquire in what state of health the party from whom the scab has been taken was at the time of vaccination, and report.—Animo Complecti.

[51645.]—**Positions of Eccentric Sheaves.**—To "T. F."—Thanks for your reply. There are a few points I am not sure I understand you about. The inclosed sketch, I hope, will help to explain. (First) Ought not the crank to be on top centre or bottom, to commence with? (Secondly) You say I am to draw centre line through eccentrics. I have shown one eccentric on shaft cutting line at F—is this as you mean? Now, it seems to me there must be a proper place to draw the lines through eccentrics, either the widest or the narrowest part; and that this line must of necessity be marked through both eccentrics at the same place, else the one eccentric will work differently to the other. Would you kindly explain positions, &c., and oblige; also say what is the best kind of link motion?—A. S.

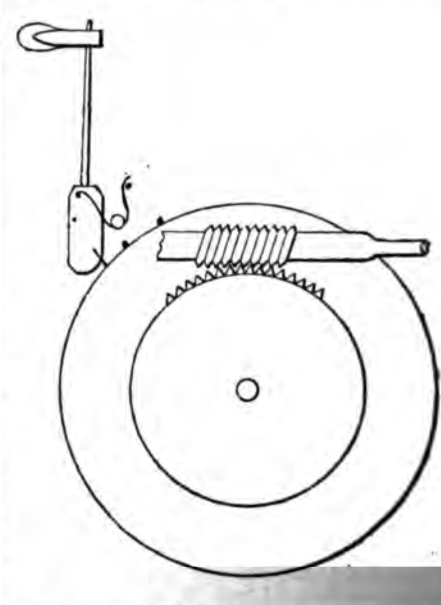


[51733.]—**Retouching Negatives.**—In the first place you require something in the shape of a retouching desk, a sketch of one of which is annexed, but which may be simplified by the omission of the drawer which is intended for the reception of the leads and other etceteras, and by the substitution of a sheet of finely ground glass for the frames for holding the negatives. A sheet of white paper, cardboard, or other material should be placed on the bottom to reflect the light upwards through the negative, and an opaque cloth thrown over the head of the operator, and the top of the desk to keep out light from the sides. You will also require an assortment of lead pencils of various degrees of hardness, some fine sand or glass paper to sharpen them upon, a small sable or camel-hair brush, and some Prussian blue. If you use gelatine plates the retouching may be done on the surface of the gelatine, but on the whole I think it is best to varnish them first. If a soft, retouching varnish be used, no further preparation should be required, but an ordinary hard negative varnish usually requires some preparation either with one of the retouching mediums sold for the purpose, or by roughing the surface. The latter may be accomplished as follows:—Take an old or spoiled plate and rub up the varnish with a piece of glass paper, then take a little of the fine powder thus produced on the tip of a finger and rub it gently over the part to be retouched. The pencils should be ground to a very fine point, the wood being cut away and some half inch or more of the lead laid bare. Then having struck off a proof from the untouched negative, note carefully what marks require removal, what shadows softening, and high lights strengthening, and work on the negative accordingly. Should there be any pinholes, or other marks too deep for pencil to remove, touch them out with the brush and a little of the Prussian blue.—W. Robinson, Jun.



[51756.]—**Cartridges for Martini H. Rifles.**—Weigh out 85 grains with any weights at hand, be sure that 85 grains are in scale, pour into case, strike the case slightly on a piece of board to settle down powder, put in a cardboard wad, then a disc of wax, place two cards on top and press all gently home; put in a papered bullet and seal firmly on the wad and the thing is accomplished. I see that "Artillery Man" states in last "E. M." that the cases are not solid drawn. He is mistaken: they are solid drawn brass shells, and these are the only description that can be successfully manipulated for home filling. The Government cartridges are lapped latteen brass for the sake of cheapness. All small bores are fitted with solid cases, and the Martini is no exception. My cases for Sharp, Remington, and Martini are of this class, and can be used over and over again. If "T. H. H.'s" cases are solid, he will be able to remedy a grave defect which exists in the Government cartridges—viz., the absence of a felt wad, such as used in other better served Sb.'s I punch out of ordinary shot gun wads a wad to fit bore of rifle ·450, and place it on top of powder before I put in cardboard wad. This wad, following the wax wad, effectually cleans out the fouling, leaving the barrel in as good condition after a hundred rounds as it was the first shot. Another advantage the solid case has over the Government case is, the bottle shape of the solid perfectly fits the chamber in the reduction from ·577 to ·450, the mouth of the solid drawn also fits the papered bullet, and no creasing tool to tighten the cartridge is required. Curtis and Harvey's powder, of the brands I mentioned before, is the proper powder to use. Buy all requisites if you can get them; if you cannot, then get a punch to fit bore of rifle, and proceed as follows:—Punch your wads out of hardest cardboard; get two penny candles—one wax, the other tallow—melt, and pour into a tin tray, cover the bottom about ⅛in. thick, and with punch or solid case cut out the lubricating discs. I hope "T. H. H." will now have no difficulty in filling his cartridges. Should he be in any doubt, if he advertises his address I will send him sample of case, wads, &c.—Eccentric.

[51774.]—**Piano Hurdy Gurdy.**—"R. E. S." has set himself a somewhat difficult task, and one which I think, before he has accomplished it, he will consider worthy of a more euphonious title. The action of a mechanical piano is not easily illustrated, but perhaps the accompanying sketch (drawn to a scale of about 1 in 6) will be useful. The position and length of strings should be the same as in a piano, though he may humour the scale to suit the number of tunes required. There ought to be nine notes to the octave—viz., the diatonic with the sharps of F and C, other accidentals being added where necessary. The lower two octaves may be bichord, the next two trichord, and the two top octaves with four and five strings respectively.



(which number prove, as was done at D in the foregoing example), then the 4th wheel must be 72. Now prove the whole train thus: $\overset{c}{64} \times \overset{3rd}{60} \times \underset{4th}{72} \times \underset{Escape}{30} = 8,294,400 \div \underset{Pinions}{8 \times 8 \times 8} (= 512) = 16,200$, as should be. If 4th wheel should not be seconds, work the numbers as before. Should they be, for example, c 80, 3rd 64, escape 15; 3rd and escape pinions 8 each, then 80 × 64 × 30 = 153,600, ÷ 64 = 2,400) 16,200 (6·75 = the ratio or times the 4th pinion is contained in 4th wheel; now 8 is the most likely, so try it:—8 × 6·75 = 54 for the 4th wheel, and gives 16,200 per hour, when by the product of the 3rd wheel, 80, 64, and 30 ÷ the product of the three pinions of 8 each. The next thing to do is to find the diameters of the missing wheel and pinion. Now this is very easy when you know how, but you want two very necessary instruments—a depth tool, and a vernier inch gauge, usually called a thousandth of an inch gauge; it will measure to $\frac{1}{1000}$ of an inch (every watchmaker should have one). Now with the depth-tool take the distance from 3rd to 4th hole; this is called the pitch line, and knowing the numbers of the wheel and pinion, from the P. L. can be calculated their diameters. Rule: Add the teeth of wheel and pinion it drives together, take half the sum, then say As half sum : P. L. : : wheel teeth + 2·25 : to its diameter; and for the pinion, put its number of leaves + 1·5 in the third place, and its diameter will be the fourth term. Ex. Let 3rd wheel be 60, 4th pinion 8, P. L. $\frac{4}{10}$in., then 60 + 8 = 68 ÷ 2 = 34; then as 34 : ·400 : : 62·25 : 73,235 = 3rd wheel's diameter; for pinion say as 34 : ·400 : : 9·5 : ·1111 = pinions diameter; the 4th wheel and escape pinion is worked the same way, only the P. L. must be taken from escape hole to 4th. Note: Three places of decml. will be quite near enough; then, if the 4th be an 8 or 9, increase the 3rd decml. by 2 or 1 $\frac{10}{1000}$. The number and diameter of a pinion can be found to suit a wheel when it has been pitched or geared, for, having the P. L. number of the teeth of the wheel, also its diameter, the rule is, as the number of the wheel teeth + 2·25 is to its diameter, so is the P. L. to half sum of wheel and pinion. In the last case the 3rd wheel is 60, P. L. ·400, diameter of wheel 73,235. Now, ·73,235 : 62·25 : : ·400 : 34, and as this is half sum, and wheel is 60, the pinion must be 8, as 60 + 8 = 68 ÷ 2 = 34.—R. E. B.

[51854.]—**Legal.**—As you have covenanted and agreed not to carry on, or be engaged in, the trade or business of a hot-water engineer, you cannot do so in any way whatever. If you do, you render yourself liable to action for breach of covenant, of which the purchaser can claim specific performance.—G. Russell Pridham.

[51857.] — **Mushroom Bed.** — Procure fresh horse droppings from day to day till enough has been collected to form a bed of the required size. Spread the manure out under cover, and turn frequently, so as to prevent the manure from overheating; if it is found that the centre of heap has become so hot as to turn white and mouldy, turn twice a day, bearing in mind that this appearance is an indication of the manure becoming spoilt. Only the short droppings should be collected—the straw should be carefully shaken out. When enough of the droppings have been obtained to make the bed (which can be made in a cellar, stable, or any outbuilding, by standing up some planks on edge for the outline of the bed), the manure should be firmly trodden or beaten to a depth of 15in. or 18in. The bed in a few days will begin to heat; place a thermometer in the bed; when the temperature has declined to 85° Fahr., break up the spawn into pieces about the size of hen's eggs, and dibble them in about 6in. apart; cover with about 1in. of any good soil, and place a covering of hay to the depth of 4in. over all; if in a place where the bed is likely to become dry, examine from time to time, and water if needed. In about six weeks, if you have carefully followed instructions, the mushrooms will begin to show as white threads of spawn, with small clusters of the fungus. Keep covered, and from day to day examine, and gather when large enough. If in the winter season, the shed or outbuildings should be kept as warm as possible. The temperature recommended is as near 60° Fahr. as can be maintained; but this temperature is only possible in a properly-constructed mushroom house. If the correspondent wants genuine information and details of the profitable cultivation of the mushroom, let him get "Mushroom Culture," *Journal of Horticulture* office.—W. B. Wicken.

[51866.]—**Wimshurst's Influence Machine.**—Put 12 or 14 sectors on each plate, ¾in. broad at their wide ends and ¼ at their narrow ends; length about 3½in. Cut them out of thick tinfoil and stick on with shellac varnish. I use shellac to stick the plates on to the wooden bosses. Electrical cement is also used. A metal spindle is quite as good as an ebonite one. Varnish the plates with shellac varnish, after having carefully warmed them till they are just hot enough to hold easily. The rod carrying brushes would do screwed on to the frame, but would not be so convenient. The collecting combs should be 3½in. long, and three-eighths of an inch from the plates. I think it is hardly necessary to occupy space with a drawing of the sectors. They should be the shape of isosceles triangles with the corners rounded off.—Oudeis.

[51872.]—**Bees.**—(1) Transferring is often done after September and before April if weather is warm and circumstances make it advisable; but it is better done before the former time or after the latter for general reasons; one is that after September they will not be so likely soon to fasten combs into frames, not being inclined to wax-making, and winter coming on, and early in the year they should be breeding fast and combs heavy. (2) From May to October. I should say it would with bees you name, as queens are to be got cheaper now; but care will be necessary in introducing her caged for 48 or 56 hours. (3) I do not know if you could get them in Ireland, but they are advertised by bee dealers, in England, at 5s. or 6s. this month. (4) They do, if not required for comb building. (5) Bees do not under any circumstances change syrup into honey. They will store it and after evaporation seal it up like honey, but although it seems to answer their purposes as well as honey, it always remains the same syrup. (6) To prevent it recrystallising, I do not know if cream of tartar will do better. I have never used any combs sagging. This was my experience last year. My remedy is, secure the foundation well at top, and put in bars of comb in alternation with foundation. (7) I never found eggs in extra-sized cells (by which I suppose you mean drone cells) other than drone, which are considerably larger than workers. Do you mean drones? (8) Red deal, I think. (9) I have not been to Manitoba, but should think it a good part for bees. Write to the Editor of *British Bee Journal*, where you will get this query answered.—J. I. S.

[51873.]—**Fir and Deal in Specification.**—The reason why all fir should be "best crown Memel" is because it is considered to be the best for the purpose, and the same may be said with respect to the deals mentioned. To know "the difference" you must go through the mill.—W. Hopper.

[51874.]—**Stone in Specification.**—This simply means what it says, and says what it means. Any mason will show better than one can tell you. The specification appears a very proper one, and is correctly expressed. What is it that you really want to know?—W. Hopper.

[51885.]—**Wages.**—The agreement, not being stamped, is not binding. He is a weekly servant, and a week's notice is sufficient on either side therefore. After he has entered the service of another person, he cannot claim free use of the land. Now that he has given notice, the crops, as they form parcel of his wages, become the property of the first master, and his right has ceased and become void.—G. Russell Pridham.

[51885.]—**Wages.**—In this case the use of the land, which is distinctly stated to be potato ground, is part of the wages, and obviously it does not count as wages until the crop is lifted, the time of lifting being known to a fraction of a year. "Diago" has the simple remedy to pay the proportionate value of the crop in wages, plus the cost of seed and manuring; or the alternative. He should not make such agreements, or if he does, should distinctly state on what tenure the land is used. It is preposterous to talk of the ploughman "getting wages while working for another man"; his crop is simply wages not received until it is lifted.—Nun. Dor.

[51889.]—**Hammering Cast Engine Rings.**—In answer to query on the above, "A. S." says you cannot hammer cast piston rings. I beg leave to differ, having hammered scores out to the extent of 1½in. or more. Experience in a loco. running-shed will convince anyone that he must find a way to make rings fit the cylinder after a few months' wear, without getting new ones, even if the cylinder is not round.—Griffiths.

[51892.]—**Substitute for Beeswax.**—The best substitutes for this are ceresine and ozokerit waxes. They are about half the price of beeswax. But if "J. R. W." used a small percentage of this in his dressing, and can buy in good parcels, say one cwt., I should advise him to stick to the real article, as he will find it more than doubly effectual in the properties he speaks of. Bleached beeswax is now about 160s. per cwt. It is, however, easily adulterated, and the adulteration is hard to detect. If he finds any difficulty in obtaining pure wax at price named, I will communicate with him if he publishes address.—Guernsey Cave.

[51895.]—**To Soften Old Files.**—Place them in the hollow of a clear fire till they are at a dull red heat, then take them out and bury them in the ashes underneath the grate till they are cold.—S. Austel.

[51899.]—**Medical Coil.**—Many thanks to "Os." for his kind offer to let me see his coil; but I think I know the instrument he refers to. Opticians say a smallest bottle battery will excite it sufficiently to knock a horse down: but a trial brings the power down to a very small figure. What size zinc in a bichromate battery do you require to make the power mentioned? "Watt" and "Sigma" contradict each other, but I suppose the latter is, unfortunately, correct. With regard to the thermopile, I omitted to state in the original query (page 117) that it was for a missionary and physician in tropical Africa, where heat is more abundant than bich. of potash, and it would be very difficult to get the bichrome from England. Therefore, if "Sigma" will give a short description (and cut if needful) of a pile that would give sufficient power (or the names of a few books on the subject), I shall be much obliged.—Thor.

[51904.]—**Lead Keel for Model Boat.**—The practice is to place most weight at the rudder post, which cocks the bows up in a calm, but when under a breeze it has a tendency to rise at the stern. A matter for experiment.—S. Austel.

[51905.]—**Tool Cabinet.**—Thanks to Mr. Best for his offer, and in reply to his query, the tools are carpenter's.—Wave.

[51908.]—**Shakespeare and the Stars.**—Permit me to hazard a conjecture. The "wat'ry star" alluded to seems to me an astrological allusion. This being the case, reference may perhaps be made to the planet Venus, to which the astrologers ascribed a particularly moist and fertile influence; or it may be, one of the "watery" signs is meant, either Cancer, Scorpio, or Pisces. In the former case, the "nine changes" might betoken the apparition of Venus as morning and evening star respectively, the Copernican doctrine having been promulgated before Shakespeare's time. If, however, one of the signs of the Zodiac is intended, the "changes" may refer to their periodic appearance in the nocturnal heavens. Shakespeare is not destitute of what smacks of astrology. For example, a personage in "King Lear," descanting on celestial influences, exclaims, "Tut, I should have been that I am, had the maidenliest star in the firmament twinkled on my birth."—Arthur Mee.

[51912.]—**To Violinists who are Mathematicians.**—No, nothing of that kind has been invented yet. All instruments are tuned by ear. I have tried for many years to find out some means to enable me to construct what I will call an indicator, but have not got any nearer as yet. I thought those telephone inventors might give me a hint towards its realisation, but it has not come about. What I mean by an indicator is a little instrument which would sound or show quite plain when the string vibrates the note required. It is well-known that a tuning fork or other things in a room sound when a certain note is produced, but are not affected by other notes of a different pitch. Although it seems very easy to construct an instrument of this kind, yet I have not been able to do it. I hope that some of "ours" will take it up and be more fortunate.—J. H. Schucht.

[51927.]—**Boilers.**—To "Boswell."—"Young Engineman" will find the formulas given by me to "The North" are as simple as they can be, but I will try to further explain. The tensile strength of boiler plate-iron is generally taken as 20 tons per square inch, 1 ton being = 2240lb. Now the formula is

$$\frac{\text{Tensile strength of the plate in pounds}}{\text{diameter of boiler in inches}} = \text{bursting pressure per square inch.}$$

Now in this particular case it is $\frac{20 \text{ tons} \times 2 \times \cdot 5}{83}$ = bursting pressure of solid plate, or, in other words, ½in. multiplied by 2 × 44,800 = 44,800lb., the total power required to burst the boiler longitudinally, supposing the joints to be as strong as solid plate; but as we know that joints single-riveted are only 56 per cent. the strength of solid plate, and double-riveted joints are 70 per cent., we must again multiply the above result by strength of joint. As particulars of joints are not given, I will suppose them to be double riveted, and then the formula is as follows:

$$\frac{\left\{\begin{array}{l}20 \text{ tons, or } 44800 \text{ (strength of plate)} \times 2 \text{ (two} \\ \text{sides of boiler)} \times \cdot 5 \text{ (thickness of plate)}\end{array}\right\}}{83 \text{ (diameter in inches)}}$$

$= \frac{44800}{83} = 539$lb. (pressure per square inch to [illegible]
solid plate) and 539 multiplied by ·7[illegible]
joint = 377·31b. (strength of joints), [illegible]
strength of boiler shell longitud[illegible]
weakest direction. Again, this [illegible]
get safe working pre[illegible]
would divide by 8, [illegible]
ance companies by 4, [illegible]
land b[illegible]
sure [illegible]
safe [illegible]
one [illegible]
ma[illegible]

must be reduced 10 to 20 per cent., as 94¼lb. would be allowed in case boiler was new, well constructed, and of reliable brand, as all makers brand good plates: "Best," "Best Best," or "Best Best Best," according to quality. Particulars of furnace tubes are too vague to make reliable calculations from; but supposing they are not strengthened at the seams, the collapsing pressure would be about 140lb., much weaker than shell we have been calculating, as 140lb. collapsing power must again be divided by 4 to get a safe working pressure, which would only be 35lb. for a tube 24ft. long by 2ft. 10¾in. diameter, made from ⅜in. plate, when it naturally follows that 35lb. is the strength (or safe working pressure) of the whole boiler, unless the furnace tubes are in some way strengthened. The strength of end plates can only be calculated after being either seen or minutely described on sketch, showing mode of staying. I have written so much recently on horse-power of boilers, that I feel almost ashamed to waste more time or valuable space in giving what I have repeatedly shown to be worthless, and now refer "Young Engineman" to "E. M.," August 31st, page 608, also several other numbers of last volume. The book I recommended to "The North" is in plain figures, with examples worked out in each case. It is published by S. Nicholls, Yorkshire-street, Blackpool, price 7s. 6d., and is a really good book, to be had only of the author, who I may here remark is an old correspondent to this paper. Should "Young Engineman" require further information on boiler queries or the above book, I shall be glad to correspond if he will advertise his address, as often a lot of valuable space is taken up for the interest of two or three only.—Boswell.

[51921.]—**Model Steamer.**—If you are intending to make a good working model, I should advise you to build your hull out of zinc strips, say No. 11 gauge and 1in. wide on wire ribs about 3in. apart, which are fastened to a wrought-iron keel. The details as to the arranging of the ribs and laying on the plates I could not very well explain without giving sketches which would take up too much room in "ours" if given all in one week. If you think a detailed description of my own 5ft. model would give you what you require, I shall be pleased to send it to "ours" for the benefit of all. My experience is, Don't have a wooden hull, as this soon warps and cracks with the heat.—S. Austel.

[51930.]—**Teazles.**—There are, or used to be, several fields of teazles grown in the neighbourhood of Polegate, Berwick, and Eastbourne, in the county of Sussex, and came to great perfection; but it is ten years since my last visit to that neighbourhood.—Ruby d'Or.

[51932.]—**Parasites on Bees.**—Unite weak one at once to next one to it, and spray all with dilute salicylic acid; also feed with syrup containing saltspoonful of acid to 5lb. of sugar and 1 quart of water. Spray combs in each hive and bees as well. J. I. S.

[51934.]—**Legal.**—To "W. T."—I am of opinion that the Married Woman's Property Act, 1883, does not apply to the case in question, as it relates only to questions arising since the 1st January, 1883. I presume the husband referred to was husband of M., as the wording of the query is vague. He died in January 1883, and M. would be entitled to the legacy in the ordinary course.—G. Russell Pridham.

[51938.]—**Musical.**—There is no actual reason why modern professors of music differ in naming the interval C to G flat. This, like other intervals, has different terms applied to it by different writers on harmony, some naming it an "imperfect fifth," others a "false fifth." The general name for it is a "diminished fifth." A fourth is dissonant except when an inverted fifth, that is, in the chord 6-4, and even then, according to Sir F. Ouseley, it should, in nine cases out of ten, be treated as a dissonance.—W. A. T., Dundalk.

[51940.]—**Waterwheel.**—The querist does not say whether the wheel is under or overshot, and does not give any particulars of the quantity of water available. These are required before an answer can be given.—Labor Omnia Vincit.

[51941.] — **Compound Locos.** — The high-pressure gearing is Joy's.—Vulcan.

[51941.]—**L. & N.W. Engines—Joy's Valve Gear.**—The compound locomotives on the London and North Western Railway *are* fitted with Joy's valve-gear. The two high-pressure outside cylinders have the valves placed below; but the inside [illegible] cylinder has the valve upon the top. [illegible] will again examine one of [illegible] the gear is of [illegible] positions.

acidulated with sulphuric acid, the wire will be instantly covered with copper, which will not rub off. Steel goods, such as scissors, &c., can be covered with copper by rubbing them with a rag wet with this solution.—R. A. R. Bennett.

[51944.]—**Coppered Wire.**—Iron and steel can be made to look copper-coloured by dipping the articles of of these materials into a solution of copperas. Copperas can be bought at any oilshop. You can also electro-deposit the copper on the goods; but I presume from the wording of your query that this process would be too complicated. —S. Austel.

[51945.]—**Boiler.**—By well-known formulæ both boilers would stand the same pressures; but I should say the less the number of riveted joints, the less the possibility of danger through joints giving way.—Engineer, Dewsbury.

[51945.]—**Boiler.**—Supposing the boilers were identical in every respect excepting the number of shell rings, I consider that the boiler with eight rings preferable to the boiler with eleven.—Labor Omnia Vincit.

[51945.]—**Boiler.**—Practically, the boilers are of the same strength. The chances are that the boiler with the eleven plates will give out first if tested with the other one to destruction. Everything in your case would depend on how they were set in the brickwork, and how they were used.—S. Austel.

[51947.]—**Link Motion.**—In "Allan's Link Motion," for reversing and for effecting variable expansion, both the expansion link and the valve rod are shifted by one movement of the reversing shaft in opposite directions—one upwards, the other downwards. By this means reversing may be effected with only half the vertical range of movement necessary when the movement is applied to only one of the pieces. In this case, the link is straight, and, therefore, the gearing is called "straight link motion."—Vulcan.

[51948.]—**Sanders-Bolitho Vacuum Brake.**—"To Physis."—The Great Western and Midland Railway Companies use the Sanders-Bolitho vacuum brake with modifications, or as more generally known, "*the two-minute brake.*" It has been fully described in back numbers, to which I refer your correspondent. The Midland or Clayton cylinder was illustrated, Vol. XXXII. p. 591. The steam brake on engine and tender, Vol. XXXIII. p. 68. The ejector, Vol. XXXIV. p. 548. The Midland or Clayton hose-coupling, Vol. XXXV. p. 265, and the Great Western pattern of brake cylinder, Vol. XXXV. p. 312. The defects in the system and details of failures will also be found in the same volumes.—Clement E. Stretton.

[51949.]—**Zoophyte Trough.**—Use marine glue. Heat the glass before applying. Recipes for marine glue I have seen in back numbers of the "E. M." It can be bought at any microscope shop.—S. Austel.

[51954.]—**Cement for Indiarubber Slips.**—Solutions of rubber or guttapercha, marine glue, or an ammoniacal solution of shellac.—Nun. Dor.

[51956.]—**Incandescent Lighting.**—I am not prepared to say that the EMF does remain the same. There is a good deal of misunderstanding about this matter, which is not altogether one of mere formulæ. I think that the current generated in a dynamo, even if separately excited, is modified by the external conditions to extent varying according to whether the limit of power is approached. The current in the armature modifies the polar state of the field magnets, and so the EMF produced; also, the total resistance has different relations to the external, as the number of lights is varied and the same current does not pass through, say, 3 lamps as would be passing when another circuit of 3 others is open.—Sigma.

[51957.]—**Weak Magnets.**—To "Sigma."—The weakness of the magnets is the cause of deficient action. The best way to strengthen them will be to take them apart, make a coil of wire which will slide freely over one of them, and pass a strong current in the direction to produce the proper magnetism. If you make a coil of about an inch in length and the same in thickness of No. 16 wire, and use either a Grove or 2 or 3 Smee cells, you will find how and when the desired strength is attained. The magnets should have an armature on when not in use. They ought to carry, at all events, twice their own weight. The strength might be got up by hanging weights on them singly and increasing the weight by degrees, and then using them to magnetise each other by the process of rubbing; but it would be a long job.—Sigma.

[51958.]—**Electro-Plating.**—The cause of the trouble is the not having sufficient free cyanide in the solution. Probably, also, you use anodes which are not pure silver.—Sigma.

[illegible]61.]—**Electric Testing.**—The description [illegible] confused: but it appears to indicate that [illegible] cells are wound with fine wires and the battery has not power enough to send so much current as is necessary to overcome the armature spring. At all events, the resistance is too great for the battery power.—Sigma.

[51962.] — **Water Company's Charges.**—Water rates are always payable in advance. "O." does not say when the water was cut off, and I suspect the water company were within their powers. As your correspondent is a householder, it should be a lesson to him to do his share in electing members to Parliament who will attend to their duties. As it is, the only way to compete with the water companies is to reduce the assessment for rates and pay more per pound, or to obtain a competing supply.—T. K. L.

[51963.]—**Electrical.**—With a small bichromate you might deflagrate a short piece of very fine platinum wire; but such cell would not last long whatever battery he uses, it is too small.—Watt.

[51963.]—**Electrical.**—A good battery for you. Get a glass jar and a porous jar to match; have ready, for a half-pint jar, about ¼lb. of bichromate of potash, take a leaden colander and hang on glass jar, so that when jar is half filled with water, colander is about a quarter covered, then put in ¼lb. of bichromate and pour on sulphuric acid to the extent of ½lb., which will dissolve the bichromate. Pour slowly, and stop when the liquid boils up. Put in the porous pot one part of sulphuric acid in eight of water. Two carbons go in the bichromate solution, and one zinc in the acid solution. The zinc should be well amalgamated. The carbons must be placed close to, without touching, the porous pot. A couple of thick rubber bands around each carbon, and one around both carbons holding them tight, to the porous pot, are useful. When not using the battery for (say) ten hours, the zincs and porous pots must be taken out. This battery can be used for lamps or motors. —C. R. Heap.

[51965.]— **Rash.** —Bathe the part night and morning for half an hour with soft soap and hot water, and afterwards apply the following ointment—viz., sulphur, ¼oz.; borax, 1oz.; vaseline, 4oz.; beeswax, ½oz.—The Kent Hermit.

[51966.]—**Making Small Drills.**—One way is to make the drill so that it does not go through the hole in the screwplate, but goes in the size larger easy. For example, making one for No. 10 it must not go through No. 10, but go through No. 9.—Watt.

[51972.]—**Valuation.**—You can work the sum thus:—Annual rent, less outgoings (taxes, repairs, insurance), multiplied by 12. Probable value £1,100; but depends on terms, state of repair, situation, &c.—R. Hannen.

[51972.] — **Valuation.** — Nineteen years' term from Jan. 1, 1884. Rent, £100 yearly. Query, value?

At 3 per cent. = 14·3 y.p. nett.
„ 4 „ = 13·1 „
„ 5 „ = 12·1 „
„ 6 „ = 11·2 „

Deduct 25 per cent. for all outgoings, and multiply residue by, say, 14, 13, or 12 y.p. as rate prefixed of interest. Or, say—

100 = [if nett, of course no deduction for
less 25 empties, repairs, collection, &c.]
—
75
12 y.p.
——
£900 as fair price.

(See "Investor's Tables" (2d.) to be had at 70, Lincoln's Inn-fields.)—X.

[51975.]—**L. & N. W. R. Locos.**—To "Vulcan."—In my query I asked when 148, 1012, &c., were rebuilt, not when they were built. I also asked who designed the class to which 1012 belongs only. No. 1012, 1074, 1075, 1056, and 1057 are of exactly the same class, and are stationed at Birmingham. 1012 was built in Feb. '62. The class to which 304 belongs was built from '66 to '73, by Ramsbottom; the "Lady of the Lake" class from '59 to '65, by Ramsbottom: and the large and small Bloomer classes, to which 1005 (Achilles) and 980 (Vandal), respectively, belong, from '51 to '62, by McConnel. The class to which 1888 belongs was built from '47 to '53; the date of 1888 being Sept. '47; and the class to which 148 (Penguin) belongs, by Trevithick, from '53 to '58. If interesting to any reader, I will give dimensions, stations, &c., of any engine of the above, or other classes of L. and N. W. engines; though I do not know in what year Mr. Trevithick's, McConnel's, or Ramsbottom's engines were rebuilt.—J. E. Spencer, Birmingham.

[51976.]—**Piano Wrest Plank.**—The best thing you can do is buy a set of pins. Leave the old pins in the plank, and bore the holes for the new pins ½in. above and ½in. below the crack. See that the pins fit very tight in the holes. Do one by one—i.e., put a new pin in, then uncoil the wire from the old pin and put it on the new one, pull it up in unison with the wire still left on the same note, then put that one on in the same way. This is the cheapest and most effective way to repair your piano.—J. H. Schucht.

[51977.]—**Defective Ejector.**—An ejector to work properly must have at the end of the suction pipe a very fine copper strainer, say, the holes no bigger than the eighth of an inch, and plenty of them. The discharge pipe to the sea must be straight from the ejector for, say, a foot, and then a bend, if necessary, to go through the hull. There must be no sharp angles either in the suction or the discharge. Now, in your case examine the suction and see if there are any bits of coal or coke in it by ramming a stout wire down. See if the entrance to the discharge pipe is chamfered off as well as the inside of the ejector at that part. Arrange for the discharge to come straight away from the ejector, and then carry it out above the level of the sea if possible. Of course you have a full-way cock to prevent the return of the sea.—S. Austel.

[51978.]—**Hyposulphate of Soda.**—By the term "hyposulphate of soda," I presume this querist means hyposulphite of soda, now more correctly called sodium thiosulphate. This salt can be prepared from common washing soda by saturating a strong solution of it with SO_2, and digesting the solution of sodium sulphite thus formed with flowers of sulphur for a few days, filtering, and crystallising. The SO_2 can be made by heating together charcoal and H_2SO_4, or from the combustion of sulphur or pyrites; when prepared by the action of charcoal on H_2SO_4, it is contaminated with CO_2; but this does not interfere with the above process.—W. E. Haden.

[51982.] — **Electro - Magnetic Machine.** — "A. C." will get very little from his machine if he makes it, certainly not enough to produce an electric light. "A. C." had better wait a little and read the papers by Mr. S. R. Bottone on the "Dynamo" now appearing in these pages.—Watt.

[51984.]—**Dissolving Guttapercha.**—Guttapercha is insoluble in "spirits." The solvents are bisulphide of carbon, mineral naphtha, oil of turpentine, benzol, and chloroform; but the last two are expensive and the first two those most commonly used.—Nun. Dor.

[51986.]—**Electric Currents in Dynamos.**—No effect can be greater than its cause; therefore, the polarity in the armature must be weaker than in the field; it cannot reverse, but does weaken and displace the field poles. As to my book, it is getting on, and 400 pages printed off; I suppose the printers will have it out of hand soon.—Sigma.

[51988.]—**Tapering Corks.**—There is no way of using a lathe for tapering corks. I make a machine specially for that purpose, and should be glad to give "C. W. F." information if he sends me his address. I advertise mine in this number. —J. Lowman.

[51991.]—**Astronomical.**—In reply to "Stella," I find that according to the star catalogue published in the "Encyclopædia Britannica," 8th ed., and confirmed by this year's *Whitaker*, α Andromedæ, α Coronæ, and α Ophiuchi are each of 2nd magnitude; γ Ursæ Majoris is mag. 2-3 (*Whitaker* 2), δ Ursæ Majoris 3-4 (*Whitaker* 3). Webb makes α Capricorni a wide double, giving α^1 as 4th. mag. and α^2 as 3rd. In Hubbard's *Directory*, 1882, I find amongst other publications, more or less astronomical (but none exclusively so), the following issued in Paris:—*Journal du Ciel*, issued twice a week; *La Nature* (illustrated) weekly; *Bulletin des Sciences Mathematiques et Astronomiques*, monthly. The prices are not given.—Arthur Mee.

[51993.]—**Engine Query.**—Undoubtedly your engine has either too much lead on steam side, or too small an amount of cushioning for such a speed. Close exhaust at about one-eighth of stroke if possible.—Engineer, Dewsbury.

[51994.]—**The Heliostat.**—I am afraid "M. T." will not find the instruments now being described sufficient for his purpose. Foucault's "Siderostat" is the instrument generally used in connection with a fixed telescope. The principle is exactly the same as that of the Heliostat, except (1) that the mirror must be a true plane, and silvered on the front; (2) the clock should be one with a conical pendulum, or the image will be unsteady; (3) means must be provided either with long cords acting on endless screws or long rods, to enable the observer to set the instrument while at the eye-end of the telescope; and (4) the whole construction of the instrument must be as faultless as the skill of a good optician can render it. "M. T." will find a description of the siderostat with an engraving on p. 290 of Captain Abney's "Photography."—A. T. Hare.

[51995.]—**Extracting Dust and Lime from Wool.**—A shaker, such as the Yorkshire shoddy makers use for dusting new cloth cuttings, would suit. You can buy them for hand or steam. I can show him a steam one, or I will give name of makers if you advertise your address.—R. A. J.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, W. J. Grey has replied to 51242, 51249, 51251, 51290; W. E. Haden, 51251; "Codadad," 51398; R. Hannen, 51543.

51298. Veterinary Surgeon in Army, p. 538.
51299. Dark Slide, 538.
51306. Shaping Machine of Lathe, 538.
51307. Electromotor—To "Conrad," 538.
51308. Master Taps, 538.
51309. American Bowling Alley, 538.
51311. Legal, 538.
51322. Magnetism, 539.
51329. Electro-Magnetic Machine, 539.
51331. China Painting, 539.
51335. Gilding Glass with Liquid Gold, 539.
51341. Induction Coil, 539.
51345. Electro Magnet, 539.
51355. Carbonic Acid in Liquids, 539.

51562. Burnishing and Setting Razors, p. 22.
51571. Steam Pump, 22.
51572. Oxide of Copper Battery, 22.
51575. The Passion Flower, 22.
51585. Water Motor for Blowpipe Fan, 23.
51590. Electrical, 23.
51598. Platinum in Battery, 23.
51599. Haulage, 23.
51604. To "Sigma," 23.
51607. Dissolving Human Hair, 23.
51610. G.E.R. Locos, 23.
51612. Tunnelling, 23.
51613. Knapp's Solution, 23.
51615. Brass and White Ornaments, 23.
51616. Hosiery Goods, 23.
51618. To Mr. P. J. Davies, 23.
51620. Photographic, 23.

QUERIES.

[51997.]—**Induction Coil.**—Would Mr. W. J. Lancaster kindly answer the following queries?—(1) I am making an induction coil. When finished it will measure 6in. between inside faces of reel-ends and 3¾in. diameter. For primary, two layers No. 16 silk-covered copper wire soaked in paraffin. A cylinder is formed over primary with beeswax and resin—1 to 4 resin (common)—then two thicknesses of first quality printing paper, demy white 24lb., which is thickly coated with shellac varnish. For secondary, 13 layers of No. 36 silk-covered wire. Insulation for do.: After a layer of wire is wound on it is coated with shellac varnish to the depth of double the thickness of a leaf of the "E. M.," or perhaps rather more. Four thicknesses of the printing paper (soaked in paraffin) are then carefully and tightly wrapped round. Then another coat of varnish (like one before), then layer wire, coat of varnish, paraffin paper, varnish, &c., till all the wire is on, when eight layers or thicknesses of paraffin paper will be put on and coated with varnish (shellac). What is the greatest number of one pint and also half-pint bichromate of potash cells above coil will stand with the larger of the two condensers mentioned below? (2) I propose to have foils for condenser 7in. by 6in. If I had them 5¼ by 4in. (half area) would I have to double number of cells to get same length of secondary spark? (3) Is paraffin paper (as above) a good insulator for condenser plates? Is it better than varnished paper (same quality in both being used)? (4) Finally, what is the maximum length of spark that I may expect from the secondary of such a coil, by using maximum battery power, when condenser is fitted to coil and complete?—A Recent Subscriber in Australia.

[51998.]—**Brass Whistle.**—Will some of our musical friends favour me with the fingering of the brass whistle seen in most of the windows of the vendors of musical instruments. They are constructed and holed the same as the tin whistle, but are much better finished, and in the hands of a professional yield excellent music? Full scale required with various fingerings.—Flute.

[51999.]—**Steel - facing Copper Plates.**—Will some of ours inform me how copper plates are steel-faced and the chemicals used, and oblige?—Brass.

[52000.]—**Dynamo.**—Will "Sigma," S. R. Bottone, J. Sutcliffe, or any kind reader, assist me with the following?—I am making a small dynamo. The armature is 2¼in. long, 2in. in diam., composed of 14 iron plates, having 8 coils, wound with No. 20 wire, each coil containing 9ft. I want to know what number wire, and quantity, will be required for the field-magnets, which are cast iron, having two coils each, part of magnet to receive coils 1½ long by 1¾ wide by 5 1-16 thick? Also how many lamps it would light?—Spark.

[52001.]—**Wheel Grease.**—Can "Engineer, Dewsbury," or other of your numerous correspondents, give me a recipe for wheel grease suitable to use on a spur and pinion wheels, both iron, and running at a good speed? The usual heat of engine-room is 100° F., and upwards.—Simplex.

[52002.]—**New Inman Steamer.**—Can any one give the size of engines and any other leading dimensions of the new steamer *City of Chicago*? Also builder's name.—Simplex.

[52003.]—**Defective Coil in Galvanic Battery.**—The following are the instructions for the connections: Battery to screw C and Z handles to screw No. 1 and 2. Should this power be found too weak, remove the handle to screw 3 and 4. Different degrees of power may be obtained by connecting the handles to any pair of screws; but the strongest power is when the extreme screws are employed. Would any kind reader inform me how to make a coil? Also the quality and quantity of wire to be used, and what would be the more suitable battery for the same?—J. D.

[52004.]—**Silk for Flour Dressing.**—Having an order for a silk, seven sheets in length, and only being a country joiner, I am rather at a loss as to what the probable cost of making one would be (time only), having all material found me by the party it is for? Also, would like a sketch if any of ours could oblige me.—Amateur Millwright.

[52005.]—**To Mr. Allen.**—Will Mr. Allen kindly describe the kind of apparatus that is required (and is at present in use) for the determination of the albuminoids in milk, in which use is made of a funnel and cooler?—A would-be Fat Extractor.

[52006.]—**To Mr. Lancaster.**—Ellerbeck remarks—"Length of camera should be 50 per cent. more than the length of plate, although cameras as a rule are seldom more than 25 per cent." Kindly explain exact meaning of this. What I want to get at is exact utmost length required for bellows of ½-plate camera?—Alpha.

[52007.]—**To Mr. Wetherfield.**—A sick and death society, registered under the Friendly Societies Act, 1875, some twenty years ago made some investments in freehold property. The original loans, with accumulated interest, amounted to more than its value; consequently, the property was thrown on the hands of the trustees, who have since been receiving the rents, but no separate accounts are given on balance sheets showing what is being received for rent, or what is being paid for repairs, rates, &c., but simply stating in a lump sum what is received as interest on the whole of the society's investments. Are the trustees justified under the Friendly Societies Act in holding property fifteen or twenty years, to the detriment of the society?—Bilston.

[52008.]—**Poor Rates.**—I build a house of four rooms similar to adjoining houses, having the same frontage—viz., 20ft. When the rate collector first calls he rates me like my neighbours—at £12—but verbally says he will make it 10s. more next half-year. When the next half year's rate comes it is at £15, which I refuse to pay, when others are only rated at £12. The only satisfaction I can get from the collector is the house is better built—not a jerry house. What I wish to know is if I can be compelled, only on these grounds, to pay the increased rate, and my best course to pursue?—T. T.

[52009.]—**Improving Draught of Chimney.**—Would the exhaust of an engine led into a chimney stalk improve the draught and not injure the brickwork?—T. B.

[52010.]—**Lifting Water.**—I have an unlimited supply of water with about 5ft. fall, and want to lift about say 3,000 gallons 80ft. high per day. Could you tell me what power turbine I require, and what quantity of water will it require to work it, which water, I suppose, runs to waste?—Richmond.

[52011.]—**Wads.**—Could I get the sheets of luff, which the soft wads which are put between the powder and shot in cartridges, are made out of, cheaper than buying the wads cut out?—and what composition are they made of?—F.

[52012.]—**Bicycles at Night.**—Can any reader enlighten me as to the law regarding bicycle riding at night? The other night, not having my lamps on, I carried a flaming torch in my hand, and was stopped and thrown off by a man (not a policeman). Was he justified in so doing? Could the law touch me in any way, were he to summon me, either for carrying a torch or for riding "without a light"? Must a lamp, if used, be fastened to the machine?—G. Newman.

[52013.]—**Bees.**—I shall be much obliged if some of the readers of the "E. M." kindly answer the following—viz. (1) Is it a fact that foul brood is such a terribly fatal disease among bees, as stated in the "Modern Beekeeper"?—if, so, I am surprised it does not destroy nearly all the bees in the country, where the cottager, generally leaves his skep to take care of itself as best it can, and never dreams of salicylic acid being in the world at all. When it breaks out in a hive, we are told we can distinguish it by the rotting grubs in the cells. I ask, can it be known by any other signs? Has the hive a bad smell, or can it be distinguished any other way?—and in hives which have no brood, and which takes the disease from an infected one; how can I discern it?—(most hives have little or no brood now). Is it likely to come on at this time of the year, and what time is it most general? When it sets in in a hive, is it likely to destroy it, if left to itself? If some of the many readers of the "E. M.," who must have much experience of this sadly destructive disease, would give some information about it and its cure, also an occasional letter on the modern arrangement of bees, it would be a great boon to many beginners. (2) Is flour cake better than barley sugar, or sugar cake, for winter feeding? (3) When I take out the bars for the winter, is there any fear of honey and pollen souring in the cells (surely not if sealed), having unfortunately got no extractor on account of its high price? (4) What's the difference between Woodbury frame hive and the Abbott frame hive?—J.

[52014.] — **Sawmill Waste.**—Can any of our readers inform me what is the most profitable way of utilising saw mill waste? I have a quantity of pieces of ash, beech, elm, and oak, some of which would run from 12 to 20in. long, and square from 1½in. to 2½in. It seems wilful waste to have to burn all of it.—Sawyer.

[52015.]—**Photometers.**—To Rev. T. E. Espin.—Will the Rev. T. E. Espin kindly oblige the writer with a full sketch of telescope showing precisely where the stops, prism, and light are placed?—also give the inside diameter of hole in stop for a 2¼in. object-glass, give a drawing of prism, give its position in instrument? Of what use is the prism? I have absolutely wasted several hours every day, ever since it appeared, in trying to find out the use of the prism. I know it ought to reflect, but if it is in the telescope or not makes no difference. I placed it behind the large stop, midway between the object-glass and small stop; I use for a prism a piece off a chandelier drop, about 1in. long—is that the right thing? Give also the size of hole in matchbox? When the light just peeps over the bottom of object-glass, will not the matchbox stop off a greater portion of the object-glass?—Eta Orionis.

[52016.]—**Depositing Platinum.**—I am desirous of depositing the above metal in a reguline state upon copper foil. Will some practical correspondent kindly give me the method of making a solution, and the battery power required?—also the temperature at which the solution should be used?—E. T. M.

[52017.]—**Heating Water.**—It is proposed to heat water by steam for bathing purposes in a cylindrical tank, a coil passing through the centre; it could not be brought into the house, it is 20 yards from the boiler. The water when heated has to go to about 40 yards at each side of it—that is to the extreme ends of the building. The water is highly charged with lime, and consequently will block up the pipes in a short time. Would it not be better to run the steam all the way to both ends of building and heat the water there in open tanks? I should be very thankful if any of your readers would give me wrinkles of the advantages and disadvantages of the above.—Bernard.

[52018.]—**Portable Engine—one Cylinder.**—Will some kind experienced hand inform a new subscriber, and a young hand, how to reverse his engine to make the fly-wheel run the reverse way? I understand by shifting the eccentric, it is done; but I want to find out the proper and perfect way to do it. The eccentric is now keyed on, and there is no mark on shaft where to fix it for reversing. Also explain full particulars, giving lead to engine, what is meant by it and how to do it?—New Subscriber.

[52019.]—**Gas-Engine.**—In a late number of "ours," 50108, May 11th, "R. A." gave some valuable figures relating to gas-engines, and the distribution of the heat generated in the cylinders of the better class of silent engines. The figures relating to the waste of heat from the water-jacket seemed to me to be so astonishing, that I venture respectfully to ask "R. A." if he will favour us with his authority for the figures he uses, and if he will look over the answer he gave "Carbon," and confirm it?—W. Ainsworth.

[52020.]—**Right of Entrance**—In order to reach my backyard door, I have to enter a large gateway past two people's doors, and then go up a long passage, therefore never use it, but always use the front. I have been told that after a certain time I shall lose the right to use it at all; is this correct, and how long would it have to be closed? We have the place on a lease, if that makes any difference.—W. D.

[52021.]—**Raising Lid of Iron Box.**—I am constructing for a lady a strong wrought-iron box, the lid of which will be too heavy (about 2cwt.) for her to lift. Can anyone suggest to me a simple plan by which the lid can be easily raised and lowered? It must be so arranged that it will remain stationary at any height; and its own weight not cause it to come down with a rush. I should like sketches if possible.—Vulcan.

[52022.]—**Light Waves.**—It appears to me that light waves must have altitude as well as length; and that there must be a forward motion, as well as rocking from side to side as described in textbooks, or else how can light travel? Will some kind reader inform me whether both the altitude and the length of waves are known?—and if so, what they are, for, say, red.—No. Sig.

[52023.]—**Apprentice's Overtime**—To Mr. Wetherfield or "Lex."—I am an apprentice at the office of a newspaper, where we have a daily task set us, and as soon as we have finished that task, it has been our usual custom to leave work; but now the foreman says that my master could compel us to work overtime after that task is finished. Myself and the rest of the apprentices in the office have refused to work the overtime, on account of the money they pay us being insufficient. What I want to know could they compel us to work overtime after our task is finished?—A Comp.

[52024.]—**Recovery of Sulphur.**—Can any readers give me any information as to the recovery of sulphur from spent oxide from the manufacture of coal gas, by means of carbon sulphuret? A brief but concise description of the plant necessary for the operation would oblige.—A. S.

[52025.]—**Afterludes.**—As the organist of a large chapel, I am requested at the conclusion of the hymns, chants, &c., to play what (I believe) is termed an "afterlude." As my extemporising capabilities are somewhat limited, I should be glad if any reader could recommend a book or books, containing something after the style of Smart's preludes and interludes, but more varied.—Gamba.

[52026.]—**American Clocks.**—Of two small American spring clocks, the one goes tolerably well, although the regulator has to be set rather more frequently than is agreeable; the other runs always too fast, and, when lengthening the balance-spring, it stops very soon. I have sent it two or three times to a clock doctor, who charges invariably 2s. 6d.; but does not cure the evil. Could any of your correspondents say how it can be put right? The clock seems to have sufficient vitality in its power spring, and I don't see the reason why it could not be made to run approximately right. Cheap clocks are expensive.—Dux.

[52027.]—**American Egg-Boilers**—I have bought successively two American egg-boilers with sandglass and balance weight, which tip over and sound a small bell, when the sand of the upper part has filled the lower part. The sand sometimes stops running and the eggs get uneatable. Why does the sand stop running, and how can it be cured?—Dux.

[52028.]—**Wimshurst's Induction Mac** [illegible] Will any of "ours" kindly inform me h[illegible] the above machine is made?—how are the [illegible] revolve so near one another and in opposit[illegible] wish to have particular directions as to [illegible] glass discs to the axle.—Exo.

[52029.]—**Ebonite.**—I have a[illegible] electrical machine, and accidentall[illegible] too near the fire, by which it beca[illegible] to flatten it by placing between [illegible] Can any of "ours" lead me ou[illegible] give me instructions how to flatte[illegible] that its diameter is 18in.—Exo.

[52030.]—**Photographi**[illegible] room for dry-plate work, [illegible] window to open into the o[illegible] by 11in., opening into another room. Have glazed this with deep ruby; but now find in consequence of the window getting no direct light, that it would be quite impossible to see to develop a negative—in fact I cannot see my own hand unless held up to the glass. Under these circumstances, will it be best to procure deep yellow, orange, or pale ruby glass? I do not wish to use a lamp if it can be avoided. The plates I propose to use are Edwards' extra sensitive. Also, how long will hypo. solution for fixing keep, and can it be used more than once?—Ruby.

[52031.]—**Dynamo.**—I have fitted up a dynamo, and wish to ask for a little advice from "Sigma," "S. Bottone," "W. P. A.," and others. The amature H section, soft cast iron, is 10in. long, 2¼in. diam., and is wound with No. 18 double c.c. wire. I varnished the iron first of all with shellac varnish, then put round a strip of glazed brown paper and varnished that, and then wound on the wire tightly and varnished over all. By calculation (from rules obtained from last Vols. of "ours" and Sprague's "Electricity") the R of armature is ·5 ohm. The c.i. F. M.'s are wound with same kind of wire, in a similar way, and the R is 3 ohms. There is no leakage. The commutator is a brass cylinder split diagonally, one part driven on spindle, the other insulated from it on ebonite bush; the halves of commutator are insulated from each other by vulcanised fibre 1-64in. thick. Wire from armature coil secured on commutator by a screw. Brushes, of copper wire, are arranged to swivel round commutator so as to get best position. Clearance between A. and F.M.'s, 3-32in. With a Leclanché cell in circuit, and a galvanometer connected to the brushes, I get a deflection of 90°. On taking the cell away, and running armature at 3,000 revs., I get a deflection of 15° Will some one kindly point out where I have gone wrong? I made the galvanometer according to S. Bottone's directions. The brushes are insulated from each other, and the galvanometer shows the change of current when the cell is connected to terminals, and armature turned slowly. Are the F. M.'s not sufficiently magnetised?—Labor Omnia Vincit.

[52032.]—**Leather Stains.**—I have a pair of rollers covered with leather, through which I pass certain goods in a damp state, and have latterly been bothered with the tanning from the leather staining the goods. Can I extract the tanning by immersing the roller in any liquid compound, or by any means whatever? Shall be pleased to have the opinion of "ours" on the subject.—Bothered Again.

[52033.]—**C.R.**—Wanted chief dimensions of the new C.R. locos of Mr. Drummond's designs?—J. E. Spencer.

[52034.]—**G.N.R.**—Wanted particulars of the small single-wheel engines 101A and 102A, also of 644, 678, 30, and 598.—J. E. Spencer.

[52035.]—**Copying Tracings.**—In copying tracings by Willis's aniline process it is necessary to vaporise the aniline colours. Can any correspondent tell me how this is managed? I have tried dissolving the aniline crystals in methylated spirit, and heating by a spirit lamp; but the spirit appears to evaporate and leave the aniline all in the dish. What is the proper method of procedure? I may add I coat the paper with bichromate solution as follows: Water 1oz., bichromate ½drachm, phosphoric acid (B.P.) 3 drachm. Is this a proper proportion of acid, &c.?—Ditton.

[52036.]—**Street Medical Coil.**—Will Mr. Lancaster, "Sigma," or some other electrician, kindly say if it is best to build up the coil on the bundle of wires forming the core? If so, how am I to get the brass tube to slide over same when the secondary is wound on, after the manner of a coil described in "E. M.," No. 469, 1874, as I cannot clearly understand how it is done from the description there given?—Electric.

[52037.]—**Freehold Property and Building Societies.**—A man dies, not having made a will, leaving a widow and an only son (a minor). Amongst other is a freehold property mortgaged to a building society, part of the amount advanced having been repaid in the usual way. After the lapse of about four years (the son being still under 21) the administratrix, who is the widow, wishes to pay off the balance on the said property, but the society say there is no one to whom they can legally give a release until the son attains his majority. I want to know if this is correct. If not, could you kindly quote a precedent, and greatly oblige?—A Minor.

[52038.]—**Boiler.**—Will any reader tell me which is best? I have at present two boilers working with 70lb. with reducing valves on. Would it save coal if I took the reducing valves off and work the boilers at 30lb.?—H. P.

[52039.]—**Scagliola?**—In the new "school of art" here I observe a number of columns—square and round—presenting the appearance of, say, highly-polished porphyry; but on examination they are found to consist of of a cast-iron tube covered with this material. How is this put on, and how is such a high polish attained?—A., Liverpool.

[52040.]—**Apprentices and Housework.**—Would "Lex," or any legal correspondent, answer the following?—Can a master legally compel an apprentice to do his housework, and is an apprentice obliged to obey his (the master's) wife's commands? If he is not, what means (legal) could he use to get out of doing it?—E. H. Gutteridge.

[illegible] **Dynamo Electric Machine.** [illegible] me to make my machine [illegible] structed it from instruc- [illegible] Feby. 7, 1879, also [illegible] this time. The [illegible] divisions, having [illegible] m wire in each [illegible] way, and [illegible] cted [illegible] 'e to [illegible] of [illegible] fect; then I put the current through all the machine, and this gave good results; then I tried the inner poles with a compass and found two norths facing one another and two souths. On running the machine at from 1,000 to 2,000 revs. per min. only got a very weak current. Can any reader inform me where my mistake is? If any one will, I shall feel greatly obliged.—Williams.

[52042.]—**Faulty Telescope.**—I should be glad if any of your able readers versed in telescopic matters could set me right on the following: Mine is a 3in. o.g. of two lenses, one a double convex and the other a plano or, at any rate, as near as I can tell, a plano-concave. It might be convexo-concave, but I think it is plano-concave. Whichever is outward, the following phenomenon happens: When high power e.p. is used (say 250 diam.) on first mag. star I get a good disc, but round it are some peculiar rings, alternately light yellow and dark chocolate. They are perfectly circular, and don't agree with me, I can tell you. With lower powered e.p. it is the same, but not so marked.—R. I. N. G. S.

[52043.]—**Limelight for the Lantern.**—I want to make a simple and yet effective apparatus for communicating a slow rotary motion to the limes used in lantern oxy-hydrogen limelight. The clockwork arrangement sold by opticians is beyond my purse, and the bevel wheels or coil used (in lieu of this) troublesome. Can Mr. Lancaster, or any of "ours," suggest how one with a fair amount of mechanical skill could make such an apparatus?—A sketch would greatly oblige.—Iota.

[52044.]—**Induction Coil.**—Will any of ours tell me the length and diameter of core, also size of wire, and number of layers for primary most suitable for a coil where the secondary consists of about 11oz. of No. 36 silk-cov. wire? What length spark ought it to give with one pint bichromate?—L. W. Willis.

[52045.]—**Checks upon Tramway Fares.**—Can any of "ours" describe the check upon fares adopted by the different tramway and omnibus companies, both English and foreign, and oblige?—Lletram.

[52046.]—**Midland Express Engine.**—Will some kind reader give me details of a fine new express engine just turned out (last week), No. 1602, also Nos. 1603 and 1604, which have been turned out to-day?—Historian.

[52047.]—**Midland Ry. Engine.**—Will "Meteor" oblige with details and numbers of 10 very powerful shunting engines lately built? Also what traffic the little engines Nos. 1322, 3, 4, 5, 6 are intended for?—Historian.

[52048.]—**Oxychloride Mercury.**—Wanted very badly a simple test for the purity of this preparation. I am told that a pure sample should completely volatilise over a Bunsen burner, and that any residue would be an adulterant. I get a considerable residue from my consignments. Will our analysts, with their usual kindness, please assist by saying if this test may be relied on?—R. W. J.

[52049.]—**Railway Gate Hinge.**—Can some correspondent kindly give sketch and dimensions suitable for a railway crossing gate 20ft. long? Also for occupation gate 10ft. length?—Railroad.

[52050.]—**Rolling Stock.**—Wanted some information as to dimensions, tires, &c., of different sorts of passenger and goods rolling stock in America and Canada; sketches will oblige.—Railroad.

[52051.]—**N.B.R. Locomotives.**—Could any friend oblige by giving dimensions of the N.B.R. Co.'s, four coupled bogie express locos.? They take the Midland Scotch expresses between Edinburgh and Carlisle.—N. B. R.

[52052.]—**Spectrum, Temperature of.**—I want to show the difference of temperature in the different bands of a spectrum, thrown by a limelight through a bisulphide of carbon prism, on to a screen about 8ft. from nozzle of lantern. Would the best way be to use a thermo-electric pile and galvanometer multipler bearing a small reflector to magnify deflection? If so, what would be the best form of thermopile?—and also the best size of wire for coil of galvanometer?—L. U.

[52053.]—**Valve Spindles.**—Will someone kindly favour me with instructions how to prevent indiarubber sticking to valve spindles? I intend using a piece of tube made of fine rubber for packing—will it do?—Elela-Rath-Vera.

[52054.]—**Flute.**—"Vulcanite" or "Old Blowhard" would much oblige by the method used to find the proper places on a flute of any given length and bore. (1) For distance from top to aperture for blowing. (2) The distances of the other holes from said blowhole, and the length of pipe to be left below the lowest hole. Also the usual diameter of bore at present considered best, and whether cylindrical or taper, and what form of tool is best for cylindrical, and what for taper boring, with any hints for finishing smoothly, &c.?—Constant Reader.

[52055.]—**L. and Y. Locos.**—Would some correspondent kindly give principal dimensions of the above company's bogie engines, as 669? Also of tanks like 111?—Vulcan.

[51056.]—**To "Sigma."**—I have an acquaintance who has been confined to bed for about five months. His right foot and knee are very much swollen. If the knee gets any less the foot will get as much thicker, and *vice versa*. A medical man has been attending him during this time, and the only treatment has been to paint it with iodine, which seems to do no good whatever. As an amateur mesmerist, I should like to try the effect of mesmerism upon it, but never having mesmerised any one in bed before, or for any complaint, I should like some advice in the matter. It has been my intention to draw it from the knee to the foot and outwards at the toe end.—Student.

[52057.]—**Imitation Glass.**—There is a method of treating pasteboard advertisements to give them the appearance of having a glass front. I think gelatine is the substance used. I have tried gelatine alone, and also one part gelatine to four parts glycerine; but have failed. I should feel very grateful if anyone would tell me what is the real substance used, and how applied?—Advertiser.

[52058.]—**Liquids Immiscible with Oil.**—Would any reader of ours kindly name any liquids heavier than water, which would not mix with oil? (mercury excepted).—Conical Plug.

[52059.]—**Telephonic.**—Can any of our readers inform me concerning the new telephonic transmitter alluded to in the *Standard* of Oct. 16th, which will transmit both loud and soft sounds?—also the following details concerning the Blake transmitter? (1) Of what material and thickness should the diaphragm be? (2) What form of carbon answers best? (3) What quantities and sizes of wire should be used in the induction coil? (4) Will two No. 2 Leclanché cells be a suitable battery for a short circuit (20 ohms)?—St. Barto.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

Pattern Making.—It may interest "Orderic Vital" (letter 21912) and others to know that we have in preparation a series of papers by the author of "Pattern Making," which anticipate all that "O. V." asks for. Further articles on cognate subjects will also appear by the same author.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 17, and unacknowledged elsewhere:—

J. T. Chapman.—McCowen and Heald.—F. C. Farrow.—Jones Bros.—D. Fraser.—A. S. Gladstone.—J. D. Morrison.—P. J. Davies.—J. E. A.—Bow.—H. N.—G. W. W.—J. P., Stafford.—Boswell.—P. M.—Cork Wood.—L. M. B.—W. H. C.—J. Johnson.—Pressure.—P. A. D.—L. S.—Arthur R. Hallett.—Pantograph.—Cyclist.—F. Wetherfield.—S. Austel.—A Fellow of the Royal Astronomical Society.—Meteor.—T. G. Elger.

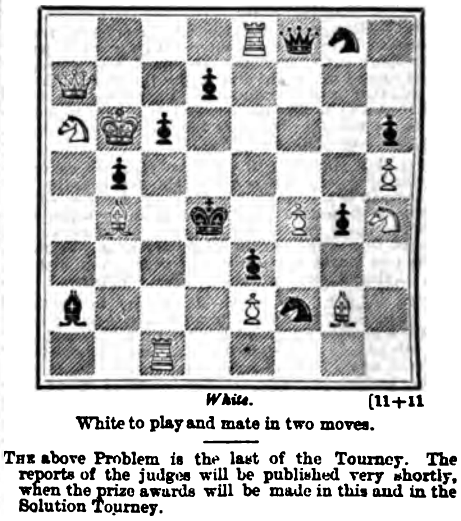
Combustion. (It depends upon the conditions in which it is burned. Twelve times the weight of coal is the short answer; but if a chimney stack is used as a draught producer, about twice that quantity. See pp. 329, 338, 360, 458, Vol. XXXV.)—Alif. (The process has been described many times in back numbers, but "full instructions" means so much, that we doubt whether you will find them anywhere. See pp. 74, 125, Vol. XXVII., and the indices since. You will find one process described on p. 580 of the last volume.)—Luminous. (You will find a recipe in No. 739, p. 256; but you can buy it cheaper than you can make it on a small scale.)—E. J. A. B. (Refer to p. 5, No. 859, for the principle of one, and p. 326, No. 763, for illustrated description of Cowper's writing telegraph.)—F. B. (Look through the indices. It is impossible to answer such a question without giving a list of alloys. Perhaps you will find something to suit on p. 134, last week.)—Belto. (We must refer you to back numbers. They are usually made of pieces of zinc and copper. There is a description of a good one in No. 301, p. 348.) G. R. K. (See the indices of the last seven volumes, or p. 95, No. 914.)—Nemo. (We have given several electric engines in recent volumes. Perhaps you might find one to suit you.)—Workman. (You do not say "foreman" of what; but presuming you mean of mechanics, you will find Templeton's "Workshop Companion," Lockwood and Co., and Molesworth's Pocket-book, E. and F. N. Spon, useful.)—Jaquis. (You should have looked through back numbers. We cannot afford space for working drawings of interest to only one or two correspondents, and in your case you can get what you want from Mr. Hallewell, of Hanover-street, Manchester.)—Another in a Fix. (Look up the subject in back numbers. You do not mention what is the composition of the solution, and yet expect somebody to guess what is the matter with it. Probably the best thing to do will be to recover the silver and make up a new bath. For methods of recovering, see p. 168, No. 917. In all probability, it is spoilt by the rosin.)—X. Y. Z. (You should have said how you "put it together," or, preferably, have referred to back numbers, where the construction is described very fully. It is briefly manganese and coke in a porous cell, and zinc outside, sal-ammoniac being the excitant. The order may be reversed.)—G. Fryer. (You do not appear to understand that the idea of using tubes is a very old one, although we have already called your attention to that fact on p. 98. If you will attempt to make an instrument with such tubes as you show in your drawings, you may possibly discover the reason why they are not adopted. You should look at the specifications at the Patent Office and consult our back volumes, or, which is perhaps the more crucial test, submit your notions to a practical man with a view to sharing in the profits.)—Nicaragua. (It is a Chiton, but of what species we do not know. We believe you will find a collection in the British Museum (Natural History), and a number of figures in L. Reeve's "*Conchologia Iconica.*")—A Puzzled Beginner. (Star charts and star maps are now within the reach of everybody; but if you look in Vol. X. you will find some articles that will help you. Possibly if you hold your map above your head and and study it in that position, you will cease to be puzzled.)—E. B. F. (You cannot make one unless you can produce an almost perfect vacuum. Your idea of corking a bottle after exhausting the air will never do. The motion is due to the action of radiant heat in causing rarefaction of the air near the surface of the vanes. Surely you remember that all the explanation possible has been given in back volumes—see index to Vol. XXIV.)—Ignoramus. (We believe there are some old-fashioned devices on the French coast, but we have no particulars. They are scarcely motors in the sense you mean.)—T. Edge. (Yes, we believe so; but under the circumstances you should consult an ophthalmic surgeon.)—W. Chapman. (If the articles are not so opaque that light cannot reach the glue, a little bichromate of potash added to ordinary glue will render it insoluble after the light has had time to act on it.)—J. F. Smith. (We have quoted the words of the Act, and can do no more. If the officials of the Patent Office will not act in the spirit, and, for that matter, according to the letter of the law, that is a question for patentees and the officials to settle between them. We know nothing of a fee of £8, and cannot understand why you should expect £7 to be refunded; but imagine that you will find the total fees are practically reduced, or section 45 is an absurdity. The fact is, it would puzzle the whole bench of judges to say what is really meant by the sub-section.)—W. Cahill. (1. No. 2. Can it, by any possibility, become inorganic?)—John S. Abbott. (You could try boiling a solution of caustic soda in it, or, if you do not mind running the risk of cracking it, you could heat it and plunge it while hot in a tub of water.)—Oudeis. (Clean with solution of washing soda, wet them with turpentine, and expose to the sun under glass. It is doubtful whether you will do much good with them. You will find several recipes in back volumes.)—Water Drinker. (Quite right; there are plenty in the market in which the filtering medium can be cleansed. See, however, p. 61.)—Per Mare. (Illustrated instructions on p. 618, No. 884.)—Butler. (No book published on the subject. There are several articles in back numbers, and several patent specifications.)—Elliot. (The *Electrical Review*, 22, Paternoster-row, would, perhaps, suit you best.)—J. F. (We suppose you mean No. 892; but surely you can look through the indices. 2. The best way to obtain a thorough knowledge is to read up the textbooks and practise the art.)—F. W. (Query answered many times. Coat with varnish, and when tacky, dust on bronze powder, or else paint with Bessemer paint.)—Pharmaceutical. (You do not explain what you mean by "chemist," and the signature suggests "druggist." You will find the question answered in both aspects in back numbers.)—N. C. (Would Mitchell's "Manual of Practical Assaying," Longmans, suit your purpose?)—A. S. (The query is indefinite—transferring what? You will find a number of recipes in back numbers.)—H. H. B. (You will find one answer on p. 462, No. 930, and several others by searching the indices. The best way in the case of small animals is to carefully bury them near an anthill or where scavenger beetles can get at them, bleaching the bones by exposure to the sun under glass.)—R. J. J. (You may find something to suit on p. 216, No. 841. The ordinary form contains a mainspring and escapement.)—B—M. (We believe the correspondent gave all available particulars, but there may be more in the *Lancet*. You have seen what Dr. Edmunds said about it.)—Correctness. (Unwin's "Elements of Machine Design" would be a suitable book, but Molesworth's Pocket-book would answer the question.)—Little Eaton. (It is a remarkable fact that such queries as yours always come from "total abstainers." A medical man must examine you, and find out if possible the cause of the symptoms you describe.)—Ham. (It depends on the cement. Try running spirit round the edge and gently prising with a knife. If that does not appear to dissolve the cement, try benzol or sulphuric ether.)—G. C. (Hoare's "Iron and Steel," 6s., Crosby Lockwood and Co., Stationers' Hall-court, E.C., is the book you require.)—A Young Mechanic. (We suppose you can use an old boot with a hole cut in it, and as the "hard substance" is not a corn or a bunion, you had better let a surgeon see it.)—A New Reader. (The best way to set about it is to hire an instrument and examine its construction. Directions for making the American organ were given in Vol. XXVI., and notes on harmonium construction throughout nearly the whole of the thirty-seven volumes completed.)—Les Dents. (Place them in a coil of wire, and pass a strong current through it.)—W. R. S. (No doubt you want a pair of suitable spectacles; but no one can give a useful opinion without examining the eyes.)—W. Brown. (We forget the publisher's address; but you can get the book of Mr. Calvert, Great Jackson-street, Manchester.)—F. A. F. (The fresh-cut surfaces of indiarubber will adhere if pressed tightly together; but the pouches are usually moulded and cured.)—A. Craig. (Without a specimen we cannot say; but oxalic acid will discharge most black inks.)—New Beginner. (Get a catalogue from Mr. Calvert, Great Jackson-street, Manchester, and see if you can find any books that are likely to be what you want.)—Ignoramus. (If the bubbles are blown by mixtures of coal-gas and air, or hydrogen and oxygen, they will explode when a light is applied.)—Moddler. (Use bleached wax for the first; but modeller's wax is made of equal parts of beeswax, lead plaster, olive oil, and yellow resin, with sufficient whiting. Colours can be added to suit. Vermilion, or any of the red pigments will answer your purpose.)—L. S. (The simplest would be a good red ink; but you could use one of the aniline colours.)—Gwalia. (You will find a number of formulæ in the "handbooks" and in back volumes; but the following keeps a long time, and is fit for use in twenty-four hours. Chloride of gold 1gr., acetate of soda 30gr., distilled water 5oz.)—Y—Cymro. (Carron oil or liniment of lime is made by shaking together equal parts of lime water and linseed oil. Use olive oil if you like. Make the lime water by slaking a piece of quicklime, and shaking it up well with water. Allow it to stand in a covered vessel, decant, and mix with the oil. Half a pound of quicklime is enough for six quarts of water.)—Bookcase. (Not too much if properly made.)—S. Boswell. (Anything that has not appeared, except a post card to hand this morning, has not reached us.)—T. E. Lingwood. (Nonsense, we have had to do it long ago on much less. You will find what you want in the advertisement pages of the *Daily Chronicle*, or any of the London local papers.)—W. H. L. (The registrar *can* claim a shilling if he calls at the house to register the birth. In one or two cases that we have met with, the registrar's "office hours" seem to have been so arranged that the above arrangement is in most cases a compulsory one. How far this is justifiable we do not know.)—J. D. D. (You had better patent it first.)—A Young Engineer. (We know of none; but a good series of articles on "Bridge Construction and Design," with plenty of illustrations, is now appearing in the *Building News*.)—E. D. Cooke. (You can sue the young lady in the County-court, but you will probably get laughed at for your pains.)—Perplexed. (It is not a question of law, but convenience. Better ask a respectable solicitor; he may perhaps himself suggest a trustee.)—A Mother. (Keep a light knitted cap on the baby's head, just reaching the tips of the ears.)—A. S. Williams. (Too late this week, and will be unfortunately valueless next.)—A., Liverpool, G. H. Lancaster, Scotus, L. O. Vincit, Salvo Jure, and others. (In type.)

CHESS

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLVII.—R. I. P.

Black.



White. [11+11

White to play and mate in two moves.

The above Problem is the last of the Tourney. The reports of the judges will be published very shortly, when the prize awards will be made in this and in the Solution Tourney.

Solution to 855.

White.	*Black.*
1. Kt-K 4	1. P takes Kt (*a*)
2. Q-R 4	2. K takes B or P moves
3. Q mates	
	(*a*) 1. P takes B (Q) (*b*)
2. Kt-Kt 3 (ch)	2. K moves
3. Q mates	
	(*b*) 1. P takes B (Kt) (*c*)
2. Kt-B 2	2. K moves
3. Q mates	
	(*c*) 1. K takes B
2. Q-Q 4 (ch)	2. Anything
3. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 853 by F. P. P.; to 854 by D. Mackay, F. P. P., Dicky Sam; to 856 by R. A. Bennett, Dicky Sam, C. Planck (a charming and accurate little puzzle), J. B. of Boxford.

S. Seymour Follwell.—Your solution to 855 is not correct: if 1. $\frac{\qquad}{\text{P-Q 7}}$ 2. $\frac{\text{Q-K R 4}}{\text{P-Q 8 (Kt) (ch)}}$.

H. Vivian.—Thanks for game.

Mac.—In 849 if 1. $\frac{\text{R-R 4 (ch)}}{\text{B covers}}$, Kt can't move to Q Kt 6 mating, as W K would be in check. We were not aware that the works in question were out of print. You would probably find the help you want in Miss Beechey's "Chess Blossoms" recently published. The price, we believe, is 2/6; the authoress's address, 16, Prince of Wales-terrace, Dublin. We are always glad to see attempted solutions, even if incorrect.

W. Anderson.—It is impossible to mate if 1. Kt-K B 3; but see solution above.

English Mechanic Tourney game between Mr. Jowett (*White*) and Mr. Clothier (*Black*):—

(Scotch Gambit.)

1. P-K 4, P-K 4 / 2. Kt-K B 3, Kt-Q B 3 / 3. P-Q 4, P takes P / 4. B-Q B 4, B-B 4 / 5. P-B 3, Q-K 2 (*a*) / 6. Castles, P-Q 3 / 7. P-K R 3, P takes P (*b*) / 8. Kt takes P, Kt-K 4 / 9. B-Q Kt 3, P-Q B 3 / 10. B-K B 4, P-K B 3 / 11. R-K sq (*c*), P-Q Kt 4 / 12. Kt takes Kt (*d*), B P takes Kt / 13. B-K 3, B takes B / 14. R takes B, B-K 3 / 15. P-Q R 4, P-Q Kt 5 / 16. Kt-K 2, P-Q R 4 / 17. Q-Q 3, Kt-K B 3 / 18. B takes B, Q takes B / 19. P-K B 4 (*e*), Castles [illegible] P-B 5, Q-B 2 (*f*) / 21. Q takes P, Q-Q R 2 / 22. Q-[illegible] Q R-Q sq / 23. Q-Kt 3 (ch), K R sq / 24. K-R [illegible] 25. R-Q B sq, R-K B 3 / 26. Kt-Kt 3, K R-Q [illegible] B sq, Q R-Q 5 / 28. K R-K sq (*h*), R-Q [illegible] Q-K B 7 / 30. Q-B 5, Q R-Q 5 / 31. [illegible] Q takes R P (*k*). [illegible] Kt-R 2, R-Q 7. [illegible] Q-K 7 / [illegible] Kt: [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 26, 1883.

THE FUTURE OF THE TELEPHONE.

IT cannot be doubted that the action of those holding the telephone patents in this country and in the United States has done much to check invention; but there are signs that before very long such companies as hold control of existing patents will be ready enough to adopt any really useful improvement, instead of buying it up and practically burking it. Mr. Preece, at the recent meeting of the British Association, in the course of a paper on telegraphic intercommunication, described the telephonic system adopted by the Post Office, which has been brought to so great a degree of perfection that London telephone subscribers, who are debarred from its advantages, envy their provincial brethren who are fortunate enough to have the Post Office telephone system at their service. Mr. Preece expressed the opinion that when attacks as to the validity of the patents ceased and things settled down, the companies, finding the Post Office had a better system, would adopt it; but with a touch of irony he explained that the Post Office switch board would probably not be used, for the simple reason that it is not patented. Whatever may be the ultimate fate of the telephone companies, it is quite certain that they do not satisfy Londoners, the majority of whom would willingly see the whole telephone exchange system handed over to the monopoly of the Post Office. For the sake of progress in connection with the telephone, one might hope that neither the Post Office nor a company will be able much longer to practically crush invention, for as we have pointed out before, the inventions of Reis show that no one now living can claim to have discovered the principle on which the telephone acts. On p. 542 of the last volume we gave an account of the decision of the examiner of "interferences" in the United States, which introduced an opportunity for long-continued litigation between Bell and McDonough, and the decision in our courts, though not quite so sweeping or confusing, it will be remembered, still leaves the monopoly of the receiver practically to Bell. Whether that monopoly will be broken down by the best of all means—other inventions—remains to be proved; but there are at least a few coming forward, which in the event of a less sweeping judgment in the appeal cases now pending in America, may have a chance of being developed in time into public favourites. For instance, Prof. Dolbear has invented what he calls the static telephone, which is not much affected by induction or bad weather. The instrument is tolerably well known; but it formed the subject of a discussion at the late meeting of the American Association. The instrument consists of a ring of ebonite, within which are two metal plates, parallel to each other, and separated by a body of air, a non-conductor. The line carrying the current is connected to one plate, and the other is caused to vibrate, when what may be considered the enlarged terminal of the wire is electrified. This system dispenses with magnetism and a return circuit (the body
the equivalent); but it re-
electromotive force, and
There
transmitter and sounds can still be heard across a room. Instruments that have been used for some time work better than new ones. Whatever may be said by special pleaders, and those who have to administer the law, there are few scientists who will not agree with Prof. H. A. Rowland, that such an instrument as Dolbear's static telephone is entirely different in principle to the magnetic telephone. When the plates are charged one hears better, and the explanation is the same as that which applies to the Thomson electro-meter, which is more sensitive when the jar is charged, in consequence of the attraction then being proportionate to the square of the difference of potential, instead of only the simple difference. Prof. Dolbear says that the instrument is a most delicate electro-meter, and when fully charged and in good working order one can apply the instrument to his ear, and hear himself speak, even when the two plates are connected with each other through the induction coil. Trials made with this telephone on a line between Boston and New York show that it is scarcely, if at all, affected by bad weather for insulation, and that, probably in consequence of the high electromotive force, any induction from neighbouring telegraph lines is very slight, and does not interfere with work. It will be seen from this brief account that the static telephone is deserving of more attention than it has yet received, for it seems especially well adapted for work in such crowded towns as London.

Another new telephonic system is that of Mr. A. F. St. George, by means of which the inventor claims that messages can be transmitted long distances, with very little interference from inductive action, and with much ease in working. The transmitter in this system consists of a disc of carbonised wood (or other suitable organic matter), which is resonant and capable of conducting electricity. This disc is supported in a frame having an aperture to direct sound-waves on to one face, while behind it hangs by a fine metallic wire a ball of very hard carbon. This ball touches lightly against the disc, and when the latter is vibrated by sound-waves, the former makes little excursions over the disc, thus bringing fresh points of contact into use. The connections are made in the usual manner with a battery and the primary wire of an induction coil. So far, there is nothing very novel in the arrangement, nor in the receiving instrument, which consists of two or more discs of mica, arranged parallel with each other in close order, and mounted at their edges in such a way that they are free to vibrate. One side of each disc is coated with metal, preferably silver, and it is advantageous to perforate the discs at the centre. The discs are arranged with their metal faces looking in one direction, and are connected alternately with each other, one set being attached to one wire of the circuit, and the other set to the other wire. This condenser arrangement is believed to increase the audible effects produced by the receiver. The remarkable feature of Mr. St. George's invention is the recording receiver, which is intended to reproduce at any distance and at any time, the sounds originally transmitted to it. We do not know whether any experiments have been made with this receiver or not; but as the newspapers have had paragraphs about it, and several correspondents have inquired as to the truth of the statements made, we give the following description:—The novel apparatus consists of a flat transparent disc of glass, which revolves at a uniform speed. One surface of this disc is coated with a
lm sensitive to the action of the light
ordinarily known and used in photogra-
processes," and the whole arrangement
ed in a dark chamber. An aperture
is provided, through which a beam of light can pass and fall upon the surface of the sensitised plate in any desired position, and the aperture is so arranged in connection with the sensitised plate that a beam of light is made to trace a spiral line on the surface of the latter. This spiral line will, so it is said, vary in width in exact proportion with the character and strength of the vibrations of the telephonic diaphragm. The sensitised plate is developed and fixed in the usual way, and is then ready to reproduce the message at any time. That is done, or is said to be capable of being done, by passing a beam of light through the glass plate to a selenium receiver, by means of which undulations are produced in an electric current and reproduced as audible sounds in a telephone receiver. By some means or other the newspapers have been persuaded to publish a note of this invention; but it may be doubted whether any really successful experiments have been made with the apparatus, though it is not impossible that in the future something of the kind may be utilised; but we are afraid it is not the direction in which to look for that improvement in the telephone service which is so much needed.

There are other improvements which await only a favourable opportunity for introduction; but at present the "opportunity" of the inventor is confined to offering his instruments to the Post Office authorities, and experience teaches that that is not at all a wise thing to do. Nevertheless, it must be confessed that the department having decided on adopting the system has completely beaten the companies who, by permission, supply a telephonic service to Londoners; but at the same time the present aspect of affairs is crushing invention, and that in a direction which promises to become very fruitful, if only a possibility of adequate reward can be observed in the distance. Something depends on the result of the cases now awaiting decision in the United States, for besides the appeal of Bell against the decision which gives McDonough the patent for a receiver combining a magnet and a diaphragm, there is Drawbaugh's case, which reopens the whole subject. Unfortunately, these cases drag out to such a length that there is a probability of the patents running out before the final and irrevocable decision is given. All of which tends, as we have endeavoured to show, to discourage invention in a direction in which just now it is most needed.

HOW TO MAKE A CHEAP LATHE.—I.*

The Patterns.

IN this and successive papers I purpose giving such information upon the above subject that any one moderately skilful in the use of engineer's tools, as I presume most of the readers of the ENGLISH MECHANIC are, shall be able to construct a serviceable lathe capable of doing wood or metal work at pleasure. It will be very nearly, though not quite in every detail, a description of one in my own possession which I made several years since. I wanted a lathe for general wood turning chiefly, but capable of being adapted for plain metalwork also, and I did not want either to spend a lot of money or to make too protracted a job of it. Possessors of Holtzapffel's lathes and members of the Amateur Mechanical Society would, perhaps, scarcely bestow more than a glance upon it. But for the majority of English Mechanics, those who, like myself, gain their living in the pursuit of a trade, high prices are prohibitory, and a tool that will do rough woodwork as well as light metal turning is the most useful.

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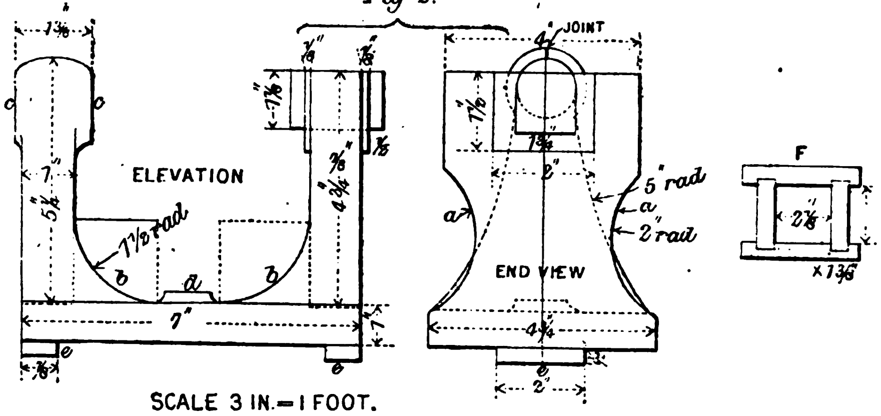
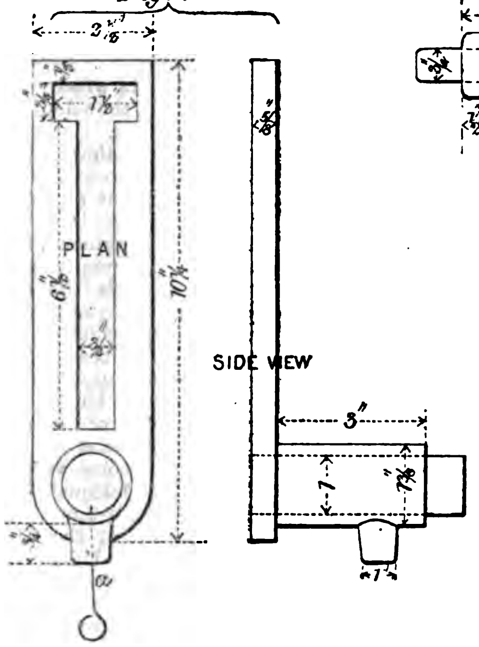
* The writer of these articles desires to say, for the information of "Orderic Vital" (letter 21912), and possibly of others also, that the outline of the present subject was sketched, and the earlier papers written, before the letter of "O. V." appeared. Without, however, departing from his original intention of describing a "cheap lathe," the writer will throw into a supplementary chapter the special information relative to the gap bed, which "O. V." desires.

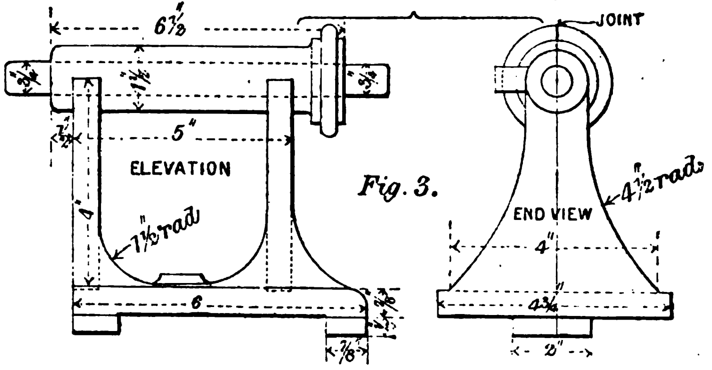
Fig 2.

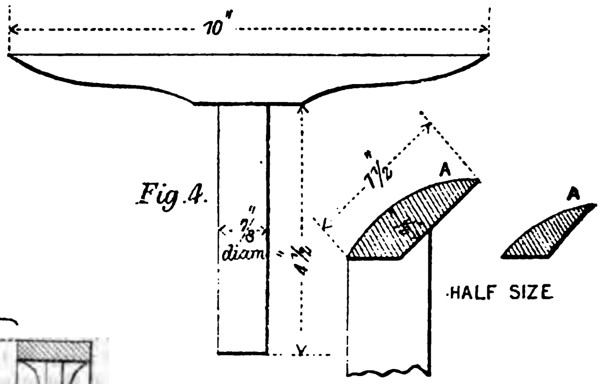


SCALE 3 IN.=1 FOOT.

Fig. 4.







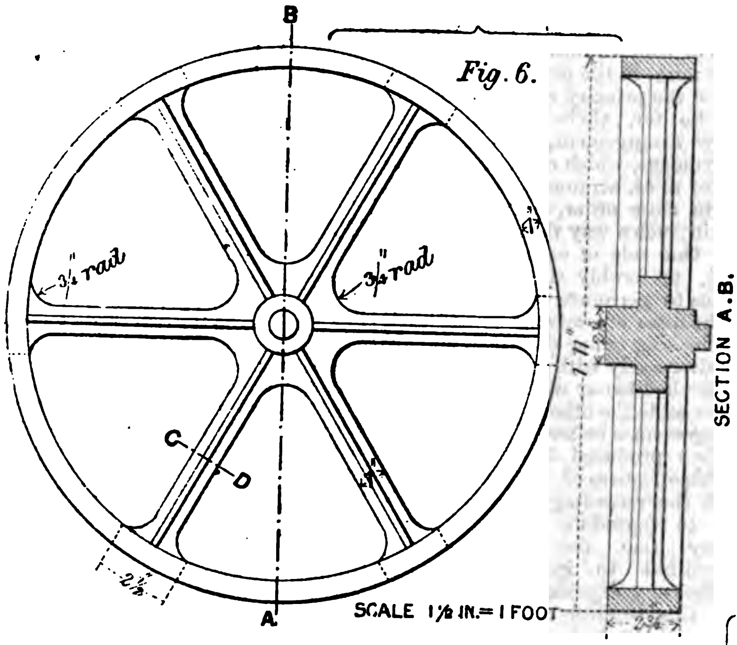
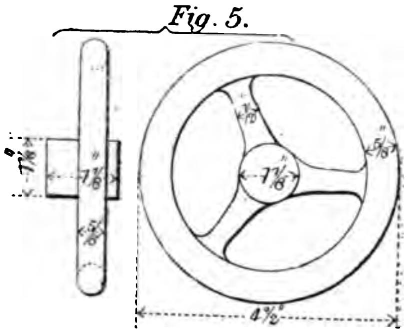


Fig. 5.



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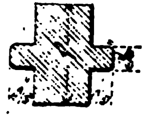


HALF SIZE

Fig. 7.

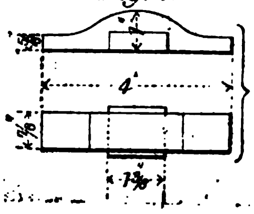


Fig. 8.

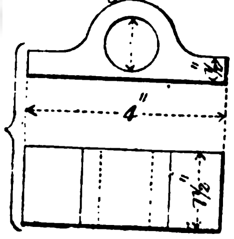
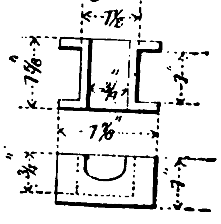
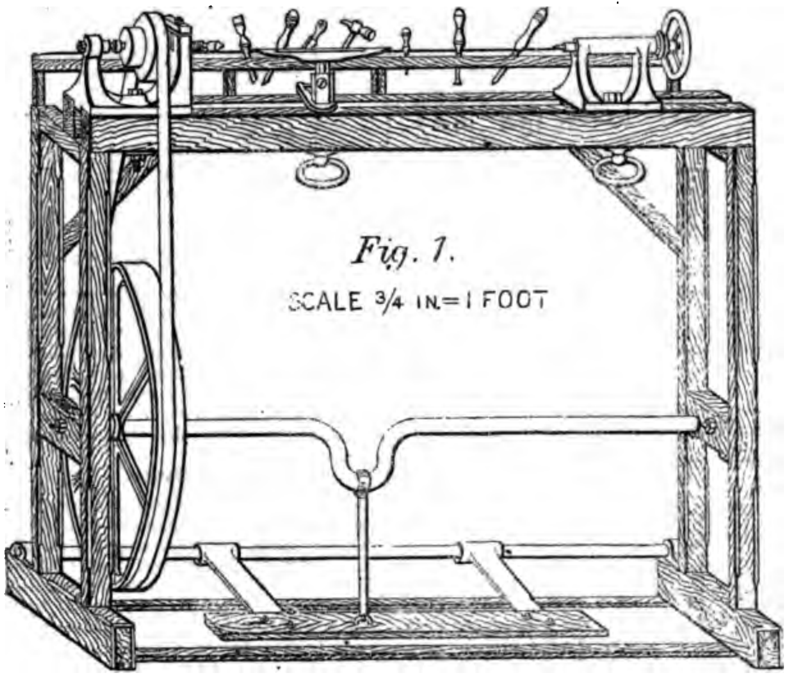


Fig. 9.





Every one, moreover, of a mechanical turn likes to possess a lathe, and a fairly substantial article is like a good microscope stand—once procured, an almost unlimited number of accessories can be added subsequently. In describing this, my lathe, I write for the benefit of my fellow craftsmen, and of apprentice youths, who often possess more ambition and ingenuity than loose cash, rather than for those wealthy amateurs to whom the outlay of a few pounds, more or less, is of little consequence. It possesses strength, lightness of motion, fair capacity, being neither a toy on the one hand, nor unwieldy on the other, and is alike suitable for wood or metal work. It is suited to the requirements of the wood turner, the pattern maker, the amateur electrician, and student of mechanics who wishes to construct his own apparatus and models, as well as for home amusement, the making of fancy articles, furniture, repairs, and so forth.

It has wood standards and a wooden bed. The poppets—5in. centres—are of cast iron. The headstock has a wooden rigger to receive a strap, and the mandrel runs in parallel brass bearings—not so good, of course, as conical steel bushed bearings, but good enough for ordinary work, and much easier for the amateur to fit up. The movable poppet carries a hollow mandrel, traversed by an internal screw (the neatest method), and the dead centre is removable at pleasure, to allow of a drill plate being slipped over the mandrel nose. The driving wheel is of cast iron, and the crank is of wrought iron throughout, casehardened at the ends, where it runs on steel centres. The bed is 4ft. long and stands 3ft. 3in. high. There is a T wood-turning, and a slide rest, besides various chucks. Fig. 1 gives a correct representation of the appearance of the lathe, as well as of the relative proportions of its parts, being drawn to a uniform scale.

We assume that our patterns are to be home made, in which case they will cost little or nothing, the material required being so small that almost any odds and ends of stuff can be rendered available. Fig. 2 represents the headstock; Fig. 3, the poppet. Both headstock and poppet will be jointed longitudinally, not because that is the only way to make them, but because it is as good as any other in the present instance.

For the headstock, then, get out two pieces for the foot, finished to 7in. by 2⅜in. by 1in., and dowell them together by corresponding edges. Also two pieces for the front of the headstock 4¾in. by 2in. by ⅞in.; connect with one dowell, and cut out the curved portions *a a*, to relieve the heavy appearance which would be produced by the upper portion (enlarged for the reception of the screws of the cap) being continued straight down to the base. Prepare two pieces for the hinder portion of the headstock. 5¼in. by. 2in. by 1in., connect with one dowel and cut curve and boss as drawn. Rebate the foot to a distance from each end equal to the thicknesses of the front and back, and to an ⅛in. below its face. Screw front and back into their respective rebated recesses, being assured that they stand at right angles with the base. Into the inner angles glue square blocks *b*, *b*, indicated by dotted lines, and when dry strike out and work 2in. radii with gouge and round plane. The boss for the back centre will be thickened up with two thin facings *c*, *c*, turned and sawn in half with a dovetail saw and fastened one on each face.

The facings for the mandrel bearing will be prepared, four pieces 1½in. by 1in. by ⅜in., and fastened in position. Two prints, also in halves, requiring four pieces 1⅛in. by 1⅛in. by ⅛in. bradded upon the facings. The boss for the tightening bolt *d*, and the guidepieces *e*, each in halves, will complete the pattern, save that the sharp edges should be taken off all round the upper portions to a $\frac{3}{16}$in. radius, to aid in giving a graceful outline to the casting. The corebox F is made to the dimensions over the prints. No hole should be cast for the tightening screw, nor for the reception of the back centre.

We will make the poppet, Fig. 3, similarly. It is as often, however, made without the longitudinal joint, the barrel being turned solid and jointed loosely to the ends. Two pieces for the base, 6in. by 2⅜in. by ⅜in.; two for each end, 4in. by 2in. by ⅜in., cut out to radii given, the barrel turned in halves to figured dimensions and notched to fit on the ends. Boss for tightening bolt and also for set-screw will be required for this pattern. Work the hollows *b b* as in the headstock, fasten on the guide pieces, and round the edges as before. In making these patterns, it is better to give a shade of taper in the direction of their draw, just a couple of shavings, say, thinner on the down side than on that next the joint, to aid in their withdrawal from the sand. This, which is very important in patterns having a deep lift, is often neglected, however, in these smaller ones, the rapping alone usually being sufficient to insure easy delivery.

For the rest, prepare the base to dimensions given (Fig. 4), cutting out the slot in the pattern to deliver itself. Turn the socket with a long print on the end, and secure to the base with a stud. Put on the boss for the tightening screw loosely with a wire *a*. For the T-piece, prepare a piece of stuff 10in. by 1½in. by ½in., and work to shape, half-sized sections being given at middle and ends A A, the shank being turned and fastened to this.

The hand wheel, Fig. 5, can be cut out of a solid piece of hard wood, exactly like the casting, to dimensions given.

In reference to the driving wheel, it will be advisable, first of all, to have a look into the secondhand dealers' shops for the chance of picking one up, with possibly a crank attached. Then if the quest fails, proceed with a pattern—in this case made flat for a belt rather than grooved, a grooved pulley involving perhaps more metal turning than many amateurs could accomplish with the appliances and tools at their disposal. Make it thus (Fig. 6):—

Build and glue up three courses of segments out of, we will say, the four of which the rim is to be composed. Full instructions for building up the rims of wheels are given in the "E. M.," Vol. XXXVII. p. 143. When built up, turn their inside diameter to finished size. Leaving the partly-made rim for awhile, plane up three strips of stuff 1ft. 11in. by 2¼in. by ⅝in. for the arms, and lock them together in the manner described on page 191 of Vol. XXXVII. On these pieces so locked together, mark out the six arms to dimensions given, leaving the portions which are to be let into the rim the 2¼in. wide to include the radii. Now, returning to the rim, recess it in six places to dimensions corresponding with those at the ends of the arms, and drop the latter into the spaces thus prepared. Lastly, over the ends glue up the last course of segments and complete the turning of the wheel.

This assumes the use of a lathe large enough to take 23in. diam., and as many persons might not be able to obtain the loan of one so large in capacity, it is well to mention that the wheel can be made well enough without a lathe at all, by striking the circular portions with trammels, and cutting carefully with paring gouge and chisel, as is sometimes done at a push, even in workshops, if the engine happens to be stopped, or all the lathes are preoccupied.

Turn two bosses 2¼in. diam. by 1¼in. thick and fasten them, one on each side of the wheel arm, putting a 1in. core print on the centre of one of them; round the edges of the arms, and put on double ribs to give rigidity and elegance of appearance.

There will be a cap for the headstock to dimensions, Fig. 7, having facings corresponding with those on the headstock; also a couple of small castings, as Fig. 8, for the treadle bar. We shall want also a pattern for the brasses, Fig. 9. For this, cut a bit of wood 1½in. by 1in. by ⅝in., also two thin pieces 1⅜in. by 1in. by $\frac{1}{16}$in. Brad these latter on the first piece as indicated, and cut out the bearing to ⅝in.

Not to be bothered with too many matters of detail at one time, and being, moreover, anxious to see some of our metalwork under way, we will get these, the chief parts, cast at once, and give our attention to chucks, slide-rest, and minor matters afterwards.

Now what about expense? The headstock and poppet will together weigh 30lb., the flywheel 70, and the rest, with the other castings, 10lb.; total, 110lb. From 12s. to 14s. per cwt., according to locality, is a fair price for this class of work, so that 15s. at the most will tide us thus far, reckoning 1s. for the two brass bearings, about a pound in weight.

ASTRONOMICAL NOTES FOR NOVEMBER, 1883.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′	h. m. s.
1	11 43 41·89 ,,	14 25 25	14 25 20	14 41 43·52
6	11 44 44·94 ,,	14 45 11	15 58 36	15 1 26·29
11	11 44 8·35 ,,	15 5 17	17 25 11	15 21 9·06
16	11 44 52·61 ,,	15 25 45	18 44 15	15 40 51·84
21	11 45 58·03 ,,	15 46 33	19 55 1	16 0 34·62
26	11 47 23·91 ,,	16 7 41	20 56 42	16 20 17·40

The method of finding the Sidereal Time at Mean Noon at any other Station will be found on p. 373 of Vol. XXXVI. The Zodiacal Light may still be looked for in the East before sunrise during the earlier part of the month. Watch should as usual be kept for spots, faculæ, &c., on every day when the sun is visible.

The Moon

Enters her First Quarter 4·4 minutes after midnight on November 7th, and is Full at 4h. 37·3m. p.m. on the 14th. She will enter her Last Quarter at 1h. 43·6m. in the afternoon of the 21st, and be New at 6·h. 54·2m. p.m. on the

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
12	60 Piscium	6	1 58 a.m.	Dark	159	197	2 34 a.m.	Bright	236	275
13	54 Ceti	6	3 51 ,,	Dark	70	109	4 35 ,,	Bright	316	355
14	σ Arietis	6	†4 9 ,,	N. by W.	189	230				
14	B.A.C. 1119	6	8 12 p.m.	Bright	67	29	9 2 p.m.	Dark*	322	287
15	B.A.C. 1206	6	2 52 a.m.	Bright	98	132	3 57 a.m.	Dark	273	312
15	B.A.C. 1468	6	†10 5 p.m.	N. by W.	189	153				
15	ι Tauri	5½	†12 33 ,,	N. by W.	186	176				
19	A² Cancri	6	11 24 ,,	Bright	106	66	12 19 p.m.	Dark	230	191
20	60 Cancri	6	†4 57 a.m.	N.N.E.	159	160				

† Near approaches. * But apparently bright.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Tr E	11	52	P.M.	14	I	Sh I	11	56	P.M.	23	*II*	*Tr E*	7	15	A.M.
1	III	Ec R	12	5	58,,	15	I	Tr I	1	9	A.M.	23	*I*	*Tr I*	9	27	P.M.
2	III	Oc D	1	52	A M	15	I	Sh E	2	16	,,	23	I	Sh E	10	38	,,
2	III	Oc R	5	26	,,	15	I	Tr E	3	29	,,	23	I	Tr E	11	47	,,
5	*I*	*Ec D*	6	20	50,,	15	*I*	*Ec D*	9	10	28 P.M.	24	*II*	*Ec D*	8	56	14,,
6	I	Sh I	3	34	,,	15	II	Sh I	11	28	,,	24	*I*	*Oc R*	8	57	,,
6	I	Tr I	4	50	,,	15	I	Oc R	12	40	,,	25	II	Oc R	2	6	A.M.
6	I	Sh E	5	53	,,	16	II	Tr I	1	55	A.M.	25	IV	Oc R	12	38	P.M.
6	I	Ec D	12	49	7 P.M.	16	II	Sh E	2	20	,,	26	*II*	*Tr E*	8	27	,,
7	II	Ec D	2	26	6 A.M.	16	III	Ec D	4	43	46,,	26	III	Sh I	10	40	,,
7	I	Oc R	4	22	,,	16	II	Tr E	4	50	,,	27	III	Sh E	2	9	A.M.
7	*I*	*Sh I*	10	3	P.M.	16	I	Tr E	9	57	P M.	27	III	Tr I	3	5	,,
7	I	Tr I	11	18	,,	16	IV	Sh I	12	1	,,	27	III	Tr E	6	40	,,
7	I	Sh E	12	22	,,	17	IV	Sh E	4	3	A M	28	I	Ec D	6	28	31,,
8	I	Tr E	1	38	A.M.	17	II	Oc R	11	39	P.M.	29	I	Sh I	3	44	,,
8	I	Oc R	10	50	P.M.	19	III	Sh E	10	9	,,	29	I	Tr I	4	48	,,
8	II	Tr I	11	28	,,	19	III	Tr I	11	24	,,	29	I	Sh E	6	8	,,
8	II	Sh E	11	47	,,	20	III	Tr E	2	59	A.M.	29	*I*	*Tr E*	7	8	,,
8	III	Ec D	12	46	14,,	20	*I*	*Sh I*	7	22	,,	29	I	Ec D	12	56	49 P.M.
9	II	Tr E	2	22	A.M.	21	I	Ec D	4	35	20,,	30	I	Oc R	4	18	A.M.
9	IV	Oc D	3	28	,,	22	I	Sh I	1	50	,,	30	II	Sh I	4	35	,,
9	III	Ec R	4	4	17,,	22	I	Tr I	2	59	,,	30	II	Tr I	6	44	,,
9	III	Oc D	5	44	,,	22	I	Sh E	4	9	,,	30	*II*	*Sh E*	7	28	,,
12	III	Tr E	11	14	P.M.	22	I	Tr E	5	19	,,	30	*III*	*Oc R*	8	25	P.M.
13	I	Sh I	5	28	A.M.	22	I	Ec D	11	3	37 P.M.	30	I	Sh I	10	12	,,
13	*I*	*Tr I*	6	42	,,	23	II	Sh I	2	1	A.M.	30	I	Tr I	11	16	,,
14	I	Ec D	2	42	12,,	23	I	Oc R	2	30	,,	30	I	Sh E	12	32	,,
14	II	Ec D	5	2	23,,	23	II	Tr I	4	21	,,						
14	I	Oc R	6	13	,,	23	II	Sh E	4	54	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

29th. Higher tides than usual may be looked for about the 14th and 15th.

Day of Month.	Moon's Age at Noon.	Souths.	
	Days.	h.	m.
1	1·5	0	52·4 p.m.
6	6·5	4	55·4 ,,
11	11·5	9	9·4 ,,
16	16·5	1	6·8 a.m.
21	21·5	5	41·9 ,,
26	26·5	9	19·7 ,,

The Moon will be in conjunction with Saturn at 5 p.m. on the 15th; with Jupiter at 7 p.m. on the 19th; with Mars at 6 p.m. on the 20th; and with Mercury at 10 p m. on the 29th.

Mercury

Is a morning Star (in the sense of Southing before Mean Noon) during the whole of November, but comes into Superior Conjunction with the Sun at 6 a.m. on the 26th. He may be probably be caught with the naked eye before sunrise during the first week of the month; but his approach to the Sun will render his detection dubious after this. His angular diameter decreases from 5·4″ on the 1st of November to 4·6″ by the 30th.

Mercury.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	13	31·6	7	31·1	10	50·1 a·m.
6	14	1·3	10	44·3	11	0·0 ,,
11	14	31·9	13	53·6	11	10·9 ,,
16	15	3·2	16	49·1	11	22·5 ,,
21	15	35·1	19	25·1	11	34·6 ,,
26	16	7·6	21	37·5	11	47·4 ,,

It will be seen from the above Ephemeris that, starting from the constellation Virgo, Mercury will travel right across Libra, and will be found at the end of November in the South-Western part of Ophiuchus. His path lies through a region destitute of any conspicuous stars.

Venus

Is an Evening Star, but is most indifferently placed for the observer through the entire month, her increasing Easterly elongation from the Sun being quite nullified by her great and rapidly-increasing South Declination. Her angular diameter increases quite insensibly from 10″ to 10·4″ during November.

Venus.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	15	8·6	17	20·5	0	26·8 p.m.
6	15	33·9	19	7·6	0	32·3 ,,
11	15	59·7	20	41·8	0	38·4 ,,
16	16	26·0	21	1·4	0	45·0 ,,
21	16	52·7	23	5·0	0	52·0 ,,
26	17	19·8	23	51·5	0	59·3 ,,

Venus's path this month commences in Libra, and after crossing that constellation and the Southern part of Ophiuchus, finishes where the last-named constellation and Sagittarius are conterminous. As we remarked above in connection with Mercury's very similar route, this lies in a part of the sky destitute of stars of any size.

Mars

Souths in the Early Morning during the entire month, but rising between 10 and 11 at night at the beginning, and soon after 9 p.m. at the end of it, may be fairly well seen after midnight. His angular diameter continues steadily to increase from 9·1″ on the 1st to 11·2″ by the 30th; and a sufficiently powerful telescope will now begin to show traces of markings on his disc. He is in Quadrature with the Sun at 7 a.m. on November 1st.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	8	45·5	19	38·9	6	4·7 a.m.
6	8	54·4	19	12·1	5	54·0 ,,
11	9	2·7	18	46·6	5	42·6 ,,
16	9	10·4	18	22·8	5	30·6 ,,
21	9	17·5	18	1·4	5	18·0 ,,
26	9	23·8	17	42·9	5	4·7 ,,

The path indicated above carries Mars from Cancer into that absolutely blank part of the sky in the Western Confines of Leo.

Jupiter

Rises between 9 and 10 o'clock at Night at the beginning of November, and about 8 p.m. at the end of it. Hence he is coming into view during the later working hours. His angular diameter increases from 36·5″ on November 1st to 39·6″ by the 30th.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	8	25·2	19	36·1	5	44·5 a.m.
6	8	26·4	19	33·0	5	26·0 ,,
11	8	27·2	19	31·0	5	7·2 ,,
16	8	27·8	19	30·1	4	48·1 ,,
21	8	28·0	19	30·3	4	28·6 ,,
26	8	27·8	19	31·8	4	8·8 ,,

This short arc lies wholly to the W.S.W. of the Præsepe in Cancer.

Saturn

May now fairly be regarded as an Evening Star, inasmuch as he is above the horizon during the greater portion of the working hours of the night. The nearer, of course, to midnight he is observed the more favourably will he be placed for the observer. His angular diameter increases insensibly from 18·2″ to 18·4″ during the month: the opening of his rings being equally imperceptible. He will come into opposition to the Sun at 4 a.m. on the 29th.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	4	29·6	19	47·1	1	49·5 a.m.
6	4	28·2	19	43·8	1	28·5 ,,
11	4	26·7	19	40·4	1	7·3 ,,
16	4	24·8	19	36·0	12	41·8 p.m.
21	4	23·1	19	32·3	12	20·5 ,,
26	4	21·4	19	28·6	11	59·1 ,,

The short arc thus indicated lies above Aldebaran, with which Star Saturn will be in conjunction at 5 a.m. on November 2nd at a distance of 3° 30′ North of it.

Uranus

Is still invisible.

Neptune

May be seen all night long, and coming as he does into Opposition to the Sun at 9 a.m. on November 12th, is in a very favourable position indeed for the Observer.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	12·1	15	59·4	12	28·3	p.m.
6	3	11·5	15	57·2	12	8·1	,,
11	3	11·0	15	54·9	11	47·9	,,
16	3	10·4	15	52·7	11	27·7	,,
21	3	9·9	15	50·5	11	7·5	,,
26	3	9·3	15	48·3	10	47·3	,,

So that Neptune will still be found in that void region of the sky to the S.E. of δ Arietis.

Shooting Stars.

The strange tale of the identification by Prof. Adams of the long-known meteoric shower of November 12—15th with the little Comet discovered by Tempel in 1866, has been so often told in these "Notes" that bare reference to it here will suffice. All, then, that will be necessary is to reiterate the caution that it is useless for the observer to begin his watch for this meteor stream until its radiant point to the North and West of γ Leonis appears above the horizon. This does not happen until about midnight, prior to which it is useless to look out. The Maximum display occurs on the Night of the 13th; but straggling members of the stream appear a night or two on each side of this date. Other displays from Andromeda, Perseus, and Ursa Major may be expected between the 24th and 28th: the night of the 27th being one on which the observer should be on the alert. Suspicions exist, too, of showers on the 19th and 30th.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of November 1st, 1883.

Star.	Souths. h.	m.	s.	
α² Capricorni	5	28	59·16	p.m.
α Cygni	5	54	47·05	,,
α Cephei	6	33	1·61	,,
α Aquarii	7	16	55·51	,,
Fomalhaut	8	8	10·98	,,
Markab	8	15	54·78	,,
δ Sculptoris	8	59	41·46	,,
α Andromedæ	9	19	9·52	,,
α Cassiopeiæ	9	50	37·89	,,
Polaris	10	33	58·28	,,
α Arietis	11	17	4·86	,,
α Ceti	12	12	30·36	,,
α Persei	12	32	17·92	,,
ε Eridani	12	43	40·17	,,

The Method of finding the Greenwich Mean **Time** of Southing of either of the Stars in the **above List** for any other night in November, will **be found** on p. 375 of Vol. XXXVI.; as will **also** the mode of determining the Local Instant **of its** Meridian Passage at any other Station. **It is** to be noted that the rules there given are not **rigidly** accurate when applied to Polaris or any **other** close circumpolar star; although they **will** doubtless prove sufficiently so for all practical purposes.

LIFE UNDER THE OCEAN WAVE.

UNDER this title Mr. P. H. Carpenter gave on Tuesday week the third of the series of Penny Science Lectures now being delivered at the Royal Victoria Coffee Hall, Waterloo-road, S.E. The chair was taken by the Rev. W. Copeland Bowie, who introduced the lecturer as the son of Dr. W. B. Carpenter, C.B., and brother of the gentleman who had addressed them on the two previous Tuesdays, Mr. W. J. Carpenter. The lecturer said he within the last five-and-twenty years, it was generally believed by scientists and zoologists, that a depth of 300 fathoms, or 1,800ft., was about the extreme depth at which any living organisms could exist beneath the sea, and that beyond this depth all was barren, owing to the great pressure of the water. It was recognised that near the shore the sea abounded with animal life; but the number of living organisms was supposed to rapidly diminish at about 200 fathoms, and from that to 300 fathoms to disappear. This belief was not, it was true, universal; but those holding a contrary opinion were but a small minority of scientific observers. Notwithstanding this generally received opinion, certain facts had been ascertained which tended to the supposition that it was wrong. So long ago as 1818, during Sir John Ross's Arctic explorations, living creatures had been brought up from depths of 1,000 to 1,200 fathoms in a perfectly fresh condition, and when people began to sound the ocean for the purpose of finding suitable beds in which to lay telegraphic cables, the prevalent belief was rudely shaken and had to be abandoned. The first proof of deep-sea animal life was given during the repair of the cable between Sardinia and Africa in 1860, so that telegraphic engineers, and not scientists, were the pioneers in this field of study. The Sardinian-African cable had to be taken up for repair in that year, and there were found on the broken pieces of cable many living organisms, some of which, from their rooted base and mature structure, had evidently been anchored to the line, and had lived on it for several years. In the year 1868, both on this and the other side of the Atlantic general interest was awakened in the problem of the conditions and character of deep-sea life, and commissions of inquiry and investigation were sent out by both the British and United States Governments. The result of these and subsequent expeditions has been that scientific observers have gradually come to the conclusion that the bottom of the sea differs as much in various parts as do similar tracts of land, that it teems in most places with animal life of the most varied kind; that there are mountains, valleys, and many undulations on the surface of its bed, covered by many different classes of soils, and that the ranges of climate are great, varying from moderately warm currents to others where the cold exceeds the freezing point in spring water, and that each of these varieties of depth, soil, and temperature is marked by its peculiar classes of organic life. He would now, with the aid of the oxyhydrogen light, turn over a few pages of the new book of submarine life which, though only revealed by these recent explorations, had been foreshadowed more than three centuries ago by the poet Spenser in one of the opening passages of an early book of "The Faërie Queene."

The lecturer then explained and illustrated the means by which deep-sea explorations were carried out. The vessel was provided with many miles of rope, marked so as to denote the distances payed out. This was coiled up along the side of the deck and was wound in after a sounding by means of a donkey engine. It was found better to drop the five or six half-hundred weights, by which the rope was loaded so soon as it touched the bottom, than to haul them up several thousand fathoms, and the manner in which the circular weights were detached from a clip by the slight shock of grounding was shown. The actual tools used were a dredge and trawl – the former in earlier expeditions was a tube provided with a leather valve opening upwards, so that the tube was open as it pierced the mud and was kept closed during the winding in. A later plan was to employ a gripping appliance, which seized a small portion of the mud and closed upon it, and this Bailey sounding apparatus, with detachable weights, was that used on the *Challenger*. Besides the dredge, there was a strong net, set on a strong iron frame and having attached to it by rods two swabs of frayed out oakum; the latter were frequently the most effective portion of the instrument, and even when the dredge, after being drawn along the bottom, came up empty, had numbers of specimens adhering to them. To prevent strain on the dredge or gripping appliance from the pitching of the ship, indiarubber accumulators were fastened to the upper end, and these yielded to the pressure; one of the sides of the dredges was also tied together with rope, so that if any great destruction were encountered in the drawing it up the rope would break and the dredge be saved. The lecturer proceeded to show on the screen enlarged pictures of the animals brought up by the tube and dredge. The most common find, both as skeletons and living examples, was an elementary organism about the size of a pin's head, consisting of a hard limestone porous base filled and covered with gelatinous substance, through which numerous sharp spicules protruded. The jelly-like substance, or protoplasm, exuded through pores in the central shell, and its arms as minute points, which were continually in movement died, their skeletons fell to the bed of the sea, and lay there closely compacted in masses resembling loose chalk. Indeed, it was found that similar structures constituted the bulk of our chalk deposits, and anyone who, remembering this, looked at the cliffs on our south-eastern coast could not fail to be impressed with the vast numbers of these minute creatures, which had gone to build them up, and this process was continually going on at the bottom of the ocean. These organisms had many varieties, differing chiefly in the arrangement of the spiny processes or arms. Some classes absorbed flinty and not limy particles from the water to build up their skeleton; many of these which had not projecting arms adhered to rocks and grew in large masses, the skeletons being familiar to all of us as sponges. One of the most beautiful examples of this class was the form called "Venus's flower-basket," originally found near the Phillippine Islands, but now known to exist in many parts.

Passing on to consider corals, the lecturer exhibited several varieties, and explained their method of growth and reproduction. Of starfishes there were a very large variety and number found in deep seas. They were symmetrically divided into five hollow rays, the centre containing a mouth on the underside opening into a capacious stomach; from apertures in the rays protruded a number of small tentacles, by which the animal moved and brought food to its mouth. A curious feature was that the young were carried, while immature, in cavities on the starfish's back. A variety frequently met with at great depths was the slenderly-formed brittle or sand starfish, and it was one of these animals, brought up in 1818 by Sir John Ross's expedition, which first set scientific men thinking that probably the deeper parts of the ocean were inhabited. Several other varieties, including the hair starfish, were shown, and the lecturer passed on to exhibit specimens of sea cucumbers, which he explained were closely allied to the well known and very abundant fossils familiarly termed sea lilies or encrinites. When mature they had annulated stems set with root-like processes, by which they fastened themselves to rocks, and a large head from which a fringe of tentacles protruded. In an immature state they swam about freely till they found a suitable anchorage. The extinct species were much larger than the modern ones; the annulated stems of some of those more numerous would, if they had remained unbroken, have been from 70 to 75ft. in length. The living species has a great range, and were found in 1867 by the *Porcupine* expedition in the Bay of Biscay and off the Norwegian coast, and had since been brought up from depths all over the bed of the Atlantic. In conclusion, Mr. Carpenter said he might be asked of what good was all this knowledge of the deep seas to the working man? It would not, he must admit, lower his baker's and butcher's bill, nor increase his power to earn money, but tended to increase our knowledge of the completeness and perfection with which the world has been made. The consideration of the wonderful way in which the deepest seas were teeming with beautiful and complex living organisms led our thoughts up from the book of nature to Nature's God.

Last Tuesday night a lecture was given by Mr. E. B. Knobel, hon. sec. of the Royal Astronomical Society, on "Comets."

HARTLEY'S DRY PLATE PROCESS.—

I.*

BEFORE giving a formula for making emulsion, I wish to state the theory upon which I base my formula, also several of the experiments I made which led me to adopt the same. Sensitiveness of a gelatine emulsion depends upon the fineness of the bromide of silver in the gelatine; the finer it is, the more rapid.

Weak solutions give finer precipitates than strong solutions. Acid solutions give finer precipitates than alkaline solutions.

Some have said that the sensitiveness of an emulsion depends upon its being more or less alkaline—the more alkaline, the more rapid—therefore they use ammonia to make it alkaline. Now, ammonia partially dissolves the bromide of silver, making it finer, therefore more rapid. It is not because it is alkaline. Anything that will dissolve the bromide of silver and not decompose the gelatine, whether it is acid or alkaline, will do the same thing. By boiling an emulsion the heat partially dissolves the bromide of silver. The more bromide that is used in excess of what it actually takes to precipitate the silver used, the less boiling it will take, because the excess of bromide will dissolve the bromide of silver, and the heat will hurry it along. The more acid an emulsion, the longer you can boil; the more

You all, no doubt, have made ammonia-nitrate of silver, by adding ammonia to a silver solution until the oxide of silver formed has redissolved. I tried this with bromide of silver, and I found by adding bromide of ammonium or bromide of potassium to a precipitate of bromide of silver, that the excess would redissolve the bromide of silver, making a clear solution, same as excess of ammonia redissolves the oxide of silver in making ammonio-nitrate of silver.

When the bromide of silver is all redissolved, it is in the finest possible state of division. I added this to the gelatine, which makes a clear, transparent mixture, and when I began to wash it, it began to emulsify. The longer I washed it the quicker it would work. I thought I had just the thing required; but on a trial I found that it was too rapid, and the plates would have to be made and handled in absolute darkness in order to work them successfully. Besides, the bromide of silver added to the gelatine in this state decomposed it, so that it was difficult to get it to set. I therefore got my fineness of bromide of silver by the same theory, but in a different way.

I also found by numerous experiments that the intensity of a negative depends upon the proportion of silver to the gelatine. The more silver, the less intensity and more detail. One half-grain of silver to each grain of gelatine will make a very intense negative, while two grains of silver to every grain of gelatine will make a very thin but full detail negative. When gelatine is boiled it refuses to set without a cooling slab, and when not heated above 140 to 150 degrees, and then only long enough to flow the plates, they set and dry without any trouble. I also find that it is not necessary to use the gelatine so thick as recommended in published formulas (namely 30 grains to the ounce), as it takes longer to set and dry, and is a waste of emulsion, as intensity can be regulated by the proportion of silver to the gelatine, and not by the thickness of the film. I also have proven, by repeated experiments, that a gelatine solution, when acid and in a jelly state, will hold 200 per cent. of silver, and when it is alkaline it will hold sometimes not more than one half-grain of silver to each grain of gelatine; this depends upon how alkaline the gelatine is. Mr. Driffield, on page 93 of *British Year Book*, 1883, states that gelatine in a jelly state will hold but a small amount of silver, and then only as a sponge holds water; that if you attempt to cut or squeeze it, the silver comes out in solution. This is only the case when the gelatine is alkaline and never when acid. Acid gelatine will hold 200 per cent. of silver, and can be cut or squeezed without danger of losing a drop of silver.

I also have proven that bromide of silver formed from alkaline solutions is not as fine as when formed from acid solutions; and that the weaker the solution of bromide, the finer the precipitates of bromide of silver.

Pure bromide of silver is not sensitive to light, but only becomes so when in combination with organic matter, such as gelatine gives to it. My formulas are based upon the above facts.

I will give my formula in detail, just as I proceed, step by step, in the making of the emulsion, and will afterwards describe the apparatus used.

Formula.

Take any hard gelatine—Swiss or Heinrich's—soak it for twelve hours in water, changing the water three times during the twelve hours. Do not cut it up. Take it out of the water and lay it on clean paper to dry. No matter how much of this you fix in this way, as when dry it will keep as before.

Take 75 grains of carbonate of soda (not bicarbonate) and 60 grains of citric acid, and put into three ounces of warm water in a quart pitcher; when the citric acid and carbonate of soda are dissolved and all effervescence ceases and carbonic acid gas has passed off, add 16 ounces cold water and 720 grains of the soaked and dried gelatine and let it stand thirty minutes; now dissolve 720 grains of silver (prepared according to formula given) in six ounces of water. Place the picher containing the gelatine in hot water—do not let the temperature exceed 110 degrees. When the gelatine is all dissolved, which will take about fifteen minutes, add the silver solution to the warm gelatine; rinse out the vessel you dissolve the silver in with two ounces of water, and add it to the gelatine solution; when the silver is added it will immediately turn white (if it turns brown the gelatine is not good, and must be discarded). Stir well. Now take a bowl large enough to hold the emulsion, wax it inside with beeswax, being careful not to leave an excess of wax; this is to keep the emulsion from sticking to the bowl. Pour the silvered gelatine into the bowl and set away in a temperature of 40 to 60 degrees to set. When this becomes a jelly, which will take about four hours, cut it into strips about one-fourth inch square, using a silver knife or horn spatula. Put strips of silver gelatine into a half-gallon [illegible] into the washing box (described [illegible]) solution through the pipe into the pitcher on to the gelatine:

Soda carbonate	150 grains.
Ammonium bromide..........	720 ,,
Alcohol	4 ounces.
Water (about 60 to 70 degrees)	12 ,,

Stir this every half-hour for two hours. When you stir it, take washing box into dark room, shut the door, and by red light only take off the cover; give it a good stirring with a glass rod and replace the cover. To tell when the silver is all formed into bromide of silver, take a small piece of the jelly to the light and cut it in two; if it is all alike, the action has taken place, if it is not the same colour all the way through, there is still free silver present. Do not put the piece back into the pitcher, as it would fog the balance. When the silver has all been formed into bromide of silver, the emulsion could be washed, melted, and plates prepared, but they would be slow. Now leave the emulsion standing in this brine of bromide of ammonium, &c., from one to five days or more, according to rapidity you want. Three days makes a rapid plate, five to six days makes a very rapid plate. The reason of this is the excess of bromide of ammonium partially dissolves the bromide of silver. The longer it remains in the brine, the finer it becomes; also, the weaker the brine, the finer the bromide of silver. But by making it weaker than is recommended here takes too long for the bromide of silver to form.

To Wash the Emulsion.

Let the water run through the tube to bottom of pitcher and off at faucet below. To tell when the emulsion is sufficiently washed, take some of the waste water running from the faucet into a two-ounce bottle and add a few drops of silver solution; there will be a precipitate of bromide of silver. In an hour take some more of the waste water, and add a few drops of silver solution, and if there is no precipitate of bromide of silver, the emulsion is washed enough. If there is still a precipitate of bromide of silver, continue to wash until, upon trial, there is no precipitate formed. Stirring the emulsion several times will hasten the washing. Never take off the cover to the washing box, except in red light after you add the brine.

The emulsion is now ready to be preserved for future use, or to be used at once.

To use at once, tie a piece of coarse canvas over a large bowl, pour the emulsion on to canvas and let it drain free of excess of water; put back into pitcher and place into hot water in apparatus described hereafter. Melt at a temperature of 140° to 150°. Add two ounces alcohol and two ounces pure albumen. (To prepare the albumen, beat the white of eggs to a stiff froth and set aside to go back to liquid.) Add two drops of a saturated solution of chrome alum in water to each ounce of emulsion: this is to keep the gelatine from frilling. There should be 35oz. of emulsion when finished; if not, make up with water. Make smaller quantities in proportion.

To Flow the Plates.

Filter the emulsion through a piece of moist flannel in the glass funnel, placed in the tin funnel as described hereafter; filter into a small pitcher that will hold about six ounces. You can have several of those small pitchers in hot water; as you empty one you can be filtering more while you use the others. The small pitchers are for flowing out. Have your plates cleaned as described hereafter, and have them about as warm as when you varnish. Hold the plate with the left hand, the long way towards you, pour some emulsion on the centre of plate, let run to the farther right-hand corner, then to farther left hand-corner, then to corner you have hold of, and off at the nearest right-hand corner; leave sufficient on the plate to make a rather opaque film. Practice will guide you in how thick to have them. If they come out too intense, you have too much on: if too thin you have not enough on. Move the emulsion on the plate until it is smooth, and then place upon screw-eyes as described hereafter. When you have six flowed, the first one will be ready to put upon a rack to dry. As soon as a plate is coated it must be put in a dark place to dry—not even a red light should get to the plates after they are flowed. The place you put them to set should be shaded from all red or white light; a dry plate on a negative exposed for five minutes to a red light will make a transparency; so, of course, will fog if exposed too long to red light in making and drying. The plates will dry in a few hours and are ready for use.

The alcohol and albumen are added to hasten the setting and drying, and also to aid in the flowing. Gelatine and albumen flows more readily than gelatine alone; the albumen also helps to keep the silver in suspension in the gelatine.

To Keep the Emulsion.

Take the emulsion strips and put them into a wide-mouth fruit jar; pour enough alcohol on to cover the emulsion, screw on the top, and the emulsion will [illegible] you wish it, take up what you want to use, wash it to free it of alcohol, let drain and melt. Add albumen, alcohol, and chrome alum as before, and flow the plates.

If you are in a hurry and do not wish to wait the three to five days to gain rapidity, you can take emulsion as soon as all free silver has been formed into bromide of silver. Melt the emulsion, heat to 140° to 150°, add 480 grains of bromide of potassium, and let stand in the water at 140° to 150° for 30 minutes. Set aside in temperature of 40° to 60° to set, and then wash and flow the plates. But if this way is chosen, the emulsion must be washed in a different way than described above, as the soluble ammonium nitrate left in the emulsion will not wash out as in the other process of washing. When the bromide of silver is formed in the gelatine, by placing the silvered gelatine in the brine the emulsion does not take up the soluble nitrate of ammonium, so only needs sufficient washing to free the outside from the nitrate of ammonium. But in the latter case the nitrate of ammonium is all through the emulsion and must be treated as follows:—Squeeze the set emulsion through a piece of coarse canvas into a large bowl of water, take another large bowl, tie a piece of coarse canvas around the top, pour emulsion and water on to the canvas, so as the water will filter off, take emulsion with a silver spoon off of the canvas into another bowl of water; wash this way three times, let drain, melt, add the alcohol and albumen as before stated, and flow the plates.

(*To be continued.*)

DECORATING ZINC.

According to Puscher, a beautiful and permanent dark or light green coating, resembling enamel, can be applied to all kinds of zinc articles, especially those made of sheet zinc, in the following manner:—Fifty parts of hyposulphite of soda are dissolved in 500 of boiling water, and the solution poured at once, in a fine stream, into 25 parts of strong sulphuric acid. The milk of sulphur that separates will soon ball together in lumps and settle. The hot liquid containing sulphate of soda and sulphuric acid is decanted, and the cleansed zinc put in it. In a short time it will acquire a very brilliant, light green coating of sulphide, and only needs to be washed and dried. By exposing it repeatedly and for a longer time to this hot bath, the coating grows thicker and the colour darker and more brilliant. The temperature must not fall below 145° Fahr.; when it does, it should be heated up to 190° Fahr., to obtain a fine and brilliant deposit. By dipping these articles in dilute hydrochloric acid, one of acid to three of water, suphureted hyrogen is evolved, and this enamel-like coating loses its lustre and gets lighter in colour. Aqueous solutions of aniline colours have little effect upon this dull surface and none on the gray brilliant coating. The effect of marbling can be obtained by moistening the gray zinc and applying hydrochloric acid in spots with a sponge, then rinsing it off, and while still wet flowing over it an acidified solution of sulphate of copper, which produces the appearance of black marble. As the zinc has generally a dull surface it must receive a coat of copal varnish. If 15 grammes of chrome alum and 15 more of hyposulphite of soda be added to the above solution, the article will have a brownish colour. The above can all be applied to articles made of cast zinc.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

The first meeting of the session of this society was held on the 10th inst. at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.) in the chair.

Dr. Maddox called special attention to Dr. Steinberg's book, which he regarded as a very great advance upon anything of the kind which had yet been produced. Some of the illustrations, such as plate 12, Möller's typen-platte, were really marvellous specimens of the perfection to which this art has been carried.

Mr. Crisp said that Plate 16 of *Navicula lyra* was also an admirable example.

Mr. Curties exhibited a simple dissecting microscope of unknown American origin (belonging to the Rev. P. Cambridge), which was made exceptionally portable, and was much commended by Mr. Crouch and other opticians present.

Dr. H. Schröder's paper "On a New Form of Camera Lucida," was explained by Mr. J. Mayall, jun., and the instrument exhibited and its construction elucidated by drawings on the blackboard. Mr. Mayall exhibited the camera lucida after the meeting, and it was generally acknowledged to be a marked improvement upon other forms of camera lucida hitherto made.

Mr. R. Brown, jun.'s, description of his object-box was read.

Mr. Crisp called attention to the programme of the 12th annual conversazione of the Chester Society of Natural Science as being admirably arranged.

The President announced that the American Society of Microscopists had informed them that they had elected him an Honorary Fellow of the Society, intimating at the same time that the future Presidents of the Royal Microscopical Society would be considered ex-officio members of the American Society. This compliment was stated to have been conferred in return for the courtesy shown by the Society in electing as ex-officio Fellows Presidents of the American Society.

Mr. Crisp reported the decision of the committee of the American Society of Microscopists on standard eyepieces. He said that he was afraid that the committee had been somewhat misled upon a point of optical theory by the Table of Magnifying Powers published in the *Journal*. This table had now been withdrawn, and he had prepared a paper which there was not time to read at this meeting, explaining the source of the error.

Mr. Squire's paper "On a Method of Preserving Freshwater Medusæ" was taken as read, having been received during the vacation, and printed in the *Journal*. Specimens of medusæ preserved in the manner described in the paper were now exhibited.

Dr. Hudson's paper "On a New Species of Asplanchna" was, for a similar reason, taken as read, Mr. Crisp recalling the fact of the *Times* having placed the letter of the enthusiastic discoverer under the leading articles, and headed it "An Important Discovery."

Mr. E. Lovett read his paper "On an Improved Method of Preparing Embryological and Other Delicate Organisms for Microscopical Examination." A number of mounted objects, as also of the cells in various stages of preparation, were exhibited in illustration of the paper.

The President considered that this was a most excellent process of mounting, judging from the exceptional clearness of the preparations exhibited, which did not show any sign of change whatever. It was also not only a good process, but it was a cheap one, and he had no doubt that many would be only too glad to copy it.

Mr. Stewart said he thoroughly agreed with the remarks of the President as to the beauty of the slides which Mr. Lovett had exhibited. He was also satisfied as to their being proof against leakage; but he thought that it might in some instances be found useful to combine the ground out slide with the cell, because where a plain slide was used the object was apt to get out of the way when placed upon an inclined stage; whereas, if the bottom of the cell was hollowed out instead of being flat, this movement of the object towards the side was often prevented. He should, however, like to ask if any special change had been noticed in any of the objects mounted in this fluid, such as might be due to decalcification.

Mr. Hitchcock said he had been much interested in the paper before them, and having previously seen and examined the preparations, he was able to speak to their excellence. The cement which had been described was certainly very strong. He had been using a very good cement himself for the purpose, though it was not so strong as that which had been described. It was composed simply of common shellac dissolved in alcohol, and though he knew some persons did not like it, he had found it to be most serviceable. After a time it was liable to get rather brittle; but if a mixture of asphalte and gold size in equal parts was applied, it preserved the cement, and at the same time made an excellent finish. He had found this formula very useful in preserving small specimens, kept in bottles. He had also been very much pleased with the preparations of fresh water medusæ exhibited in illustration of Mr. Squire's paper, as there could be no doubt that one great desideratum for microscopists was, some method of preserving those delicate and fragile organisms by which they could be kept in bottles as well as in slides. In preserving this kind of object, at first glycerine seemed to be objectionable, because of its tendency to produce a kind of granular effect; but the alcohol appeared to harden the specimens. He should like to know if this fluid had any effect whatever on the calcareous portions of such objects, and whether the alcohol had any kind of solvent effect upon them?

Mr. Michael said he had been in the habit of using practically the same fluid for some years, and could say from experience that it was a most excellent preservative fluid, and also a very good mounting fluid, when used of various strengths, according to the requirements of the objects to be mounted. If the glycerine was present in any great quantity, it certainly had a decalcifying effect, and he should hesitate to use it for some objects. As to the cell material, he had occasionally used a similar cement, and though he had not used it largely, he had found it very good so far.

Dr. Matthews said that in finishing cells a very good preventive against the oozing out of the fluid was a small strip of the thinnest tinfoil painted on one side with gold-size, and, whilst still "tacky," applied over the junction between the cell and the cover. When this was smoothed down (and it could be done so effectually that it could scarcely be felt afterwards) the result was a perfectly tight connection, which could not possibly break. He might also mention a manner of filling cells with fluid without the possibility of getting any air bubbles inside. It was to have a small trough or cell large enough to allow an ordinary slide to be placed inside it with the cell attached in the usual way; the fluid was then poured into this trough until it filled up to a point a little higher than the top of the cell on the slide. If the object was then placed in the cell and the cover put on, there was no chance whatever of a bubble being included. As regarded preservative fluid, he might also say that he had found syrup a very good substitute for glycerine, as it had no solvent power on calcareous matter.

Mr. Lovett said he had now an experience of three or four years, but had not found any change of form to take place in the objects where proper precautions had been taken in mounting. If very dense fluid was used, it would, of course, be prejudicial to some objects; but if prepared in dense fluid and mounted in light there would be no difficulty. It was important to have the materials good in quality and properly mixed; the best way was to get them prepared by a good chemist, and it was then very easy to mix them with the gold-size. As regarded shellac, he thought it would not do at all for anything containing alcohol. The solution he had recommended would have an effect on calcareous objects if it was too strong; but in the weak form he had mentioned it would be found to have no disadvantage. He had found bubbles in some cells which had been securely fastened down; but he was inclined to regard them as vacuum bubbles, because if they had been air bubbles some of the fluid must necessarily have got out to let the air in. This cement was so perfectly proof against the action of alcohol, that he had used it successfully to stop the leaking of some spirit corks. When an air bubble was caused by the cover being pressed down on the cell so much as to cause some of the fluid to get out, it could be got rid of by pressing it out at the place where the fluid had leaked, and letting the fluid run back again when the pressure was removed, and where there had been any leakage the cement would stop it at once.

Mr. Beck said he had observed from the papers that a strong effort was to be made to establish a Natural History Station somewhere upon our coasts, and he wanted to ask if it would not be possible for them, as a Society, to promote the formation of such a station. Whether this could be done by means of a money grant, or otherwise, was of course a question for the Council, but he should like to see the Society put itself forward in the matter.

The President said he had no doubt that if this proposed station was formed it would be under the control of the Science and Art Department, and, as such, it would be a Government institution. Such an institution would probably imitate the foreign stations already established, but whether their Society could do anything in the way suggested, he was at present unable to say.

The following instruments, objects &c., were exhibited:—

Mr. R. Brown, jun.: Object-box.

Mr. Crisp: (1) Swift's Radial Microscope; (2) Mirand's Revolver Microscope; (3) Pelletan's Continental Microscope; (4) Fol's Compressorium; (5) Möller's Typen-Platte, with 400 diatoms, having the name of each photographed beneath it; (6) Fresh-water Medusæ preserved by Mr. Squire's process.

Mr. Curties: American Portable Dissecting Microscope.

Mr. Lovett: Slides of *Cottus quadricornis* (one day old); Ova of *Doris tuberculata*; young Diadem Spiders; various Crustacea; young of *Asteria gibbosa*; leaf of *Drosera rotundifolia*, with insect and *Bryum hornum*, mounted by the process described in his paper.

Mr. J. Mayall, jun.: Dr. Schröder's new Camera Lucida.

Dr. H. Van Heurck, of the Botanical Garden, Antwerp, was elected an Honorary Fellow of the Society.

In the action of "Otto v. Ashbury, Sumner, and Co.," and "Otto v. Ogden," and "Otto v. Bickerton and Co.," which were actions brought by Mr. Otto to restrain infringement of his patent No. 2081, 1876, the respective defendants have submitted to orders for a perpetual injunction in terms similar to those of the judgment given by Court of Appeal in favour of the same plaintiff, in an action of "Otto v. Linford," brought to restrain infringement of the same patent. And, further, in the similar action of "Otto v. Whittaker," judgment has also been obtained for an injunction.

SCIENTIFIC NEWS.

With the dark evenings towards the end of this month and the beginning of November, observers will have a good opportunity of detecting Comet Pons, and even when the moonlight increases next month, the comet will then have become so bright that good weather will probably enable it to be seen. The ephemeris for Greenwich midnight during the next ten days or so, according to MM. Schulhof and Bossert's corrected elements, reads thus:—

	R.A.	N. Dec.
	h. m. s.	° ′
Oct. 26.	16 54 1	53 40·4
28.	16 57 27	53 17·7
30.	17 1 5	52 55·3
Nov. 1.	— 4 56	52 38·1
3.	— 9 0	52 11·2
5.	— 13 18	51 49·4

The brightness is now about three times as great as at the time of discovery, and by the end of November will be about five times as great, always supposing the comet has not undergone any material change since its last visit. The course indicated will take the comet near Beta and Gamma Draconis, with which it will be in conjunction on Nov. 11 and 20, passing about two degrees south.

It appears that Jupiter was not seen entirely without satellites as predicted for Oct. 15. The third satellite was visible at the east limb at 3h. 56m. a.m., and about the same time the fourth made its appearance on the west limb. Several correspondents send notes of their observations, which show that the times given in the *Nautical Almanac* must be wrong.

The maximum of the sunspots occurred last year; but they have been decreasing much slower than the previous increase, and some very large spots have been visible lately.

According to Profs. Roscoe and Balfour Stewart, the annual value of the sun's heat is greater at Kew than at London, in the proportion of 100 to 58.

The Ben Nevis observatory was formally opened last week. The altitude is stated to be 4,406ft., the United States possesses two observatories of the kind, one Pike's Peak, at an elevation of 14,151ft., and the other Mount Washington, 6,286ft. Italy has three, the elevation ranging from 7,087ft. to 8,386ft.; France four, ranging from 3,989ft. to 12,199ft.; and Switzerland two, of 2,875ft. and 7,505ft. respectively.

The general conference of the International Geodetic Association, held at Rome, to discuss the question of an initial meridian for the unification of longitudes, and for the unification of time by the adoption of a universal hour, presented a report in favour to the special committee, and it is understood that Greenwich as the initial meridian was accepted by six to one. Greenwich time for the universal hour was adopted unanimously, but on the question of noon or midnight there was a division of five against two. The longitudes will thus be reckoned from Greenwich, in one direction from east to west, from zero to 360°; and the mean noon of Greenwich will thus correspond with midnight at 180°, where the date will change. As the United States, Germany, Austria, and Italy use the Greenwich meridian in navigation, Dr. Hirsch was probably correct in stating that 90 per cent. of navigators calculate their longitudes from Greenwich, and as so strong an expression of opinion was elicited, the way is paved for a settlement of the question at the International Congress to be held next year at Washington.

The Meteorological Society have received permission to adopt the prefix Royal. We suppose that in future Fellows will append to their names the letters F.R.M.S., and thus they will be indistinguishable from the Fellows of the Royal Microscopical Society.

The death is announced of the distinguished geologist, Joachim Barrande, at the age of eighty-three. He was a Frenchman by birth, but had resided during the greater part of his life in Prague, the Silurian basin of which he made classic ground to geologists. The Geological Society in 1857 awarded him the Wollaston medal.

The death is also announced of M. Alfred Niaudet, a well-known French electrician, at the early age of forty-eight.

The next meeting of the Institution of Mechanical Engineers will be held at Birmingham on Thursday, November 1st. The following papers will be read and discussed at the meeting: "On the Inventions of James Watt, and his Models preserved at Handsworth and South Kensington," by Mr. Edward A. Cowper, of London, Past-President; "On Fuel Consumption in Locomotives," by M. Georges Marié, of Paris; and "Experiments on Friction," report of the Research Committee.

An electric light worked by primary batteries has been recently exhibited, and the consequence is the appearance of some extraordinary notices. It is stated that 18 lamps, equal to 160-candle power, suffice for a Pullman car, the weight of the battery not exceeding 3½cwt., whilst its duration for a single charge is from 20 to 25 hours. The cost of working is also stated to be not more than that of gas. It is further said that the system is in experimental use on the Great Northern Railway.

Anyone desirous of obtaining an idea of a complete system for the generation and utilisation of electricity will find it in a specification recently published of a patent issued to Mr. J. S. Williams, of Riverton, N.J. It contains sixteen pages of drawings, 96 figures, and 76 pages of matter. The price is 3s. 10d. For such a patent as that, £25 is not too much to pay in fees; but it is not quite complete, as the patentee refers to two specifications of 1881 and nine of 1882, so that he has been a good customer to the office.

By direction of the Board of Trade, Mr. H. Reader Lack has issued preliminary rules for taking out patents, and has appended to them a "note" which settles the dispute as to the "practice" of the office in view of the now famous sub-section 3 of section 45 of the new Act. "Applications for letters patent made during the present year must be proceeded with in accordance with the existing laws and rules." The result of the blunder will now be a rush of would-be patentees in January, and a "block" in the office.

Dr. Hermann Wedding, of Berlin, points to the fact that when melted cast iron is allowed to chill, the first crystals which form are nearly pure iron. He suggests that by repeatedly crystallising the iron a metal of high character may be obtained from poor pig iron.

The Midland Railway Company has just bought all the Pullman drawing-room day cars now running over its line. From 1st November they will be used as first-class cars, without any extra charge being made for riding in them.

The Great North of Scotland Railway Company has adopted the Westinghouse as the brake of its system.

The West Coast Joint Stock vehicles are being fitted with both Westinghouse and vacuum brakes in place of the chain.

Mr. Clement L. Wragge, F.R.G.S., F.M.S., sailed in the steamer *Maranoa* on the 18th inst., for Adelaide, South Australia. He takes with him a valuable equipment of astronomical, meteorological, and surveying instruments, and intends to make the utmost of the voyage, and of all his travels, in a scientific point of view. A fine equatorial refracting telescope is a great feature in his equipment.

Secondary Batteries as "Empties."—In these days of school boards and science departments, of examinations and certificates, it is hard, says the *Electrician*, to realise the following: The Electrical Power and Storage Company had occasion recently to lend a secondary battery charged and ready for use. For the carriage the railway authorities claimed 22s. 6d. The battery was used and returned, the railway authorities now claiming 17s. 6d. A remonstrance was made as to the excess of charge in one direction over that in the other, which was met by the reply: "Oh! but the cells were fully charged going, and returned empty, hence the difference in the carriage."

For an etching liquid for steel the following is given:—Mix 1oz. of sulphate of copper, ¼oz. of alum, and one half a teaspoonful of salt reduced to powder, with one gill of vinegar and twenty drops of nitric acid. This liquid may be used for either eating deeply into the metal or for imparting a beautiful frosted appearance to the surface, according to the time it is allowed to act. Cover the parts it is necessary to protect from its influence *with beeswax, tallow,* or some similar substance.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

◆

THE "MIDLAND FREE PRESS" ON ENDOWMENT—THE ATTRACTION OF THE EARTH BY MARS—CLEANING OBJECT-GLASSES — SATURN — MESMERISM.

[21953.]—So effectually has your contemporary, the *Standard*, disposed of Prof. Ray Lankester, that my first idea was to leave that gentleman's "I humbly beg your pardon, Keyind State; but have you got such a thing as a few millions about you to bestow upon a pore biological researcher?" address, at the British Association, wholly unnoticed. Through the kindness of my brother correspondent, Mr. Franks, however, I have received (through you, Sir) a cutting from the *Midland Free Press* of the 29th ult., which illustrates so excellently the way in which journals of all sorts are "got at" by the Endowment of Research gentry, that I feel constrained to devote a few lines to the subject. "Science," the Leicester Mentor tells us, "goes in rags, while superstition flaunts in purple and fine linen. A scurvy grant or two to such institutions as the Science and Art Department and the British Museum, and an occasional subsidy for a Transit of Venus or a deep-sea dredging expedition, represent all the Government can think of doing for the encouragement of scientific research"—and so on. In connection with this, I would venture to point out that, while I verily believe that the nation gets at least twenty shillings-worth for every pound bestowed upon the British Museum, I have no hesitation in affirming that it is simply plundered for the benefit of a clique by the Science and Art Department. Why, it is only in your number for the 5th instant ("Scientific News," p. 105) that you reproduce from Mr. Crowther's letter the most startling statement that "the department annually obtains from Parliament £340,000, or thereabouts, out of which only 5s. 9d. in the pound is given to the direct encouragement of national science and art instruction, the remaining 14s. 3d. being 'absorbed' at South Kensington and Dublin." In other words, 71 per cent. of the sum lavished on this precious "department" sticks to the fingers of the gang of harpies at headquarters before scientific and art education generally benefits by the outlay at all! Furthermore, the Leicester luminary is as vague and wrong in his other statements as he well can be. I somehow seem to remember a certain Meteorological Department for which the Government pays £15,000 a year or so, whereof £1,000 is annually divided among certain Fellows of the Royal Society (to their lasting discredit), who are dubbed the "Meteorological Council," as an excuse for their genteel form of national pocket-picking. I further seem to recollect the subsidising of every one of the more recent expeditions to observe total solar eclipses; and unless my memory is more than usually treacherous, that most paltry and contemptible sham the "Committee on Solar Physics," also robs the Treasury annually. With reference to Transits of Venus, I may remark, *en passant*, that the gentleman who says his lesson in the columns of the *Midland Free Press*, writes as though Venus crossed the Sun's face every six months or so. It would seem, moreover, that the wicked, unappreciative State not only starves the British Museum and the Science and Art Department, but actually sanctions "schemes for plundering" science "of valuable property, which private beneficence had bequeathed for its exclusive benefit"; an illustration of which is found in the (alleged) fact that "nearly the whole of the splendid bequest made by Sir Thomas Gresham for scientific purposes, two hundred and fifty years ago, has been annexed by the Tammany Ring known as the Corporation of the City of London." I am assuredly not concerned to defend the London Corporation; but the idea of any upholder of the Brompton imposture applying the designation of a "Tammany Ring" to the Patres Conscripti of the City, is really "too-too." Then, as a matter of course, we have the example of Germany flourished before our eyes, and are informed—for the *n*th time—how research is "endowed" there. Somehow, though, we are *not* told the amount annually paid to each of the workers in the German laboratories of research; and for a very simple reason. The greedy, pushing, impudent, and noisy clique who are clamouring in this country for their "researches" to be endowed, have no thought or idea whatever of accepting the modest pittance with which a German Professor is content. They want "Solar Physical Observatories," and the like, with salaries attached which would afford a modest competence to at least a dozen of their German exemplars. Plodding on for the sheer love of truth at wages just sufficient to keep them above want, is very, very far from the notion of these gentry. To travel *en prince*, to "borrow" foreign scientific apparatus, or to go forth in luxury with packages labelled "English Government Expedition," to astonish the weak nerves of douaniers and the like—this is the sort of way in which they fondly hope to rob the struggling British taxpayer. But, says in effect, the author of the article on which I am commenting: Take the hard earnings of even the poorest contributor to the Revenue, lavish them in such expenditure as this, and the Millennium will come immediately—or sooner. "Then," exclaims this genius, in a fine burst of peroration, "then, and not till then, will the millions of money at present annually wasted in the propagation of error and barbarism by means of priests and soldiers be devoted to the noblest of all human occupations, the search after truth." Believing, as I do, that if the Church and the Army were swept from the face of the land to-morrow, the resulting chaos would afford but scant opportunity for "the search after" anything but the personal safety of the law-abiding and God-fearing citizen, I am quite prepared to endorse the words with which the *Midland Free Press* concludes: "Professor Ray Lankester, however, will have to wait a long time for the realisation of this pleasant anticipation." The article which has formed the text of my remarks would seem to have elicited a most able and incisive but temperate reply from your own excellent contributor, Mr. Franks, which I will not spoil by attempting to make a précis of, or by picking out disjointed paragraphs from a closely-reasoned sequent composition. Mr. Franks might with great advantage re-write and expand it in a form suitable to these columns.

If "J. M." (query 51951, p. 138) has access to any recent work on astronomy which gives the masses of the planets, he has only to compare the mass of the Earth with that of Mars, and do a rule-of-three sum in the following form:—Mass of Earth : mass of Mars :: Earth's attraction of Mars : attraction of Mars on Earth.

With reference to query 51961 (p. 138), I would say that I see no objection to wiping the inner surfaces of the lenses of an object glass once or twice a year with chemically-clean cotton wool wetted with absolute alcohol, and polishing them with a very carefully chosen piece of clean wash-leather. I use my own telescope at night, nearly as often, I take it, as "Achromatic" himself; and make a point of exposing it to the sun next morning whenever he is shining. It is surprising how effective this treatment is in preventing "speckles"—et id genus omne. I cannot fancy that practical opticians, like Mr. Lancaster and "Prismatique," will view the repeated rubbing and cleaning of a valuable object glass with any more favour than I do.

As Mr. Franks criticises (in letter 21925, p. 147) the reproduction of his drawing of Saturn on p. 126, I should like to ask him further whether it fairly represents the inner outline of the crape ring C? I put this question because the engraver has shown the crape ring as of absolutely equal width all round, in defiance of perspective, and as though he were giving an isometrical projection of it. As a matter of fact, I always see it decidedly wider in the ansæ, its inner edge being much nearer the planet's equatorial limb than the woodcut shows, and, possibly from insufficient optical power, not forming a rigidly continuous elliptical curve with the part crossing Saturn's face. Cassini's division, too, is much too narrow and inconspicuous in the engraving.

And, apropos of Saturn, I shall be delighted to furnish Mr. Mills (letter 21928, p. 148) with an outline of that planet under its present aspect, from which he may cut a stencil plate. I must, however, beg him to wait for another fortnight; inasmuch as I have not even a pair of compasses at the place whence I am writing. I hope to be at home by the day on which this will appear; but that will be too late for my present letter.

I may say very briefly, in reply to the question which "Sigma" puts to me (in letter 21935, p. 149), that I have witnessed exhibitions of mesmerism in which the volition of the operator was (apparently) the sole motive power in the production of various effects upon the subject. Moreover, I have seen a lad in a cataleptic or quasi-cataleptic condition support a pretty heavy chair at arm's length for a time during which I, a powerful man, should have been sorry to have held it, and to endure pricks of a pin with the most imperturbable stolidity. I could, however, never satisfy myself whether these phenomena were not partly the result of training, and partly subjective. They were exhibited for payment, and we know the tendency of those who display such things to "assist nature." Less fortunate than "Sigma" in all the private mesmeric experiments I ever made, I came definitely to the conclusion that every result I obtained was certainly a subjective one, and that beyond exciting the necessary mental condition of attention and expectancy in my patients, my own share in the matter was *nil*. I only give this, however, *quantum valeat*, as my own personal experience.

A Fellow of the Royal Astronomical Society.

STARS IN CAMELOPARDALIS—THE SPECTROSCOPE.

[21954.]—With respect to letter 21930 (p. 148), I would just remark, at the outset, that, because a certain double star does not appear in Webb, it is not safe to jump to the conclusion that it is *new*. Amidst the vast number of doubles at present known, those in "Celestial Objects" only profess to be a careful selection of the most interesting. Possibly the star referred to may be Σ 397, 3h. 24m. + 59° 59′: 8·7, 10·5 : 42·6° : 5·1″. Should this not agree, if Mr. H. will examine it again, and carefully estimate its distance in R.A., and difference of decl., from Σ 385, also some guess at its position angle, I will try to identify it.

The latest measures of Σ 400 that I can find are those by Seabroke, of Rugby Observatory, as follows:—304·9°, 1·56″, epoch 1880·08; and 301·0°, 1·39″, epoch 1880·11. And may I beg of Mr. Holmes, when speaking of Struvé's stars, to always prefix "Σ" to the number? There is, then, no need to give the constellation, or even the R.A. and decl., the Struvian number being sufficient for identification.

I regret to say I cannot see my way clear to sending a description of my stand to the "E. M.," as it would involve a *diagram*, and I decline to let the engraver play tricks with it. But if Mr. Holmes will "hark back" to old vols., he will, doubtless, find something suitable for his purpose.

Would Mr. Pearson (letter 21932) kindly indicate the cause of failure in my attempts to see the solar prominences? My spectroscope is a direct-vision, of 5 prisms (3 + 2); and gives very brilliant star spectra with the 11¼in. telescope. When used on the sun an observing telescope is fitted to it, and it then clearly divides the D line. I have tried on several occasions to catch the prominences, but without success. I carefully followed the usual directions, bringing the slit accurately in the focus of mirror, and focussing sharply on the line which separates the atmospheric and solar spectra; but no bright lines could I detect in the former. The slit was tried both radially and tangentially to the limb, with narrow slit and wide ditto, and with or without a screen of ruby glass—to isolate the bright C line—but all to no purpose. I ought to add that an eccentric stop was used, varying between 2¼in. and 4½in., as I could not endure the intense brilliance of the spectrum with full aperture. Does the fault lie in the smallness of dispersive power, or what?

W. S. Franks.

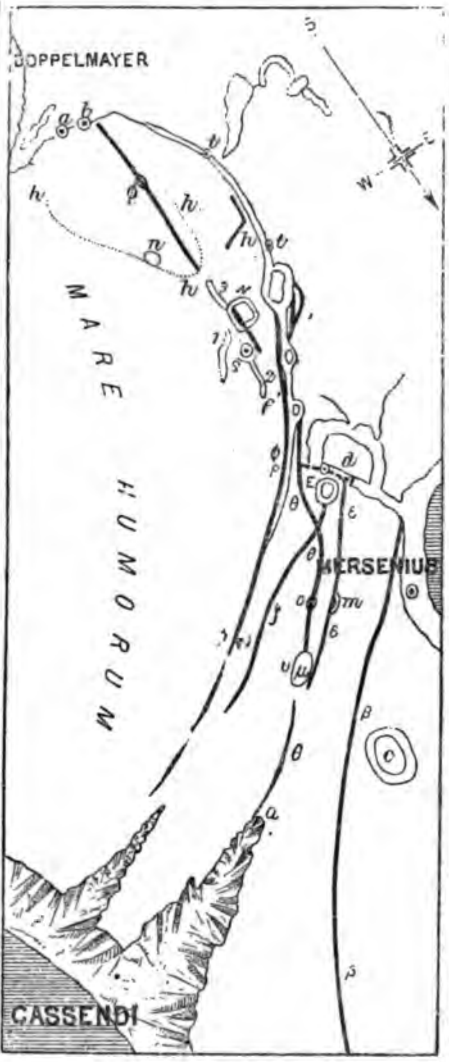
CAMELOPARDALIS.

[21955.]—The double star I referred to following 385 is just 5′ directly following that star. I now add R.A. 25° and distance rather over 3′. Bad weather renders any estimate of magnitude valueless.

Edwin Holmes.

SELENOGRAPHICAL—CLEFTS ON THE E. SIDE OF THE MARE HUMORUM.

[21956.]—These remarkable clefts were well seen between 7h. and 10h. on October 12th, the E. wall of Mersenius being on the terminator, and as published drawings fail to show them with clearness, on account of the necessarily small scale adopted, and omit some which undoubtedly exist, I herewith send a diagram of them made at the telescope, together with a brief description. The longest and most distinct of these clefts is the great Gassendi rill, β, which appears to originate at the foot of the ridge connecting Mersenius with the Ring-plain d, and, passing Mersenius C on the west, to extend far away northwards into the region E. of Gassendi. The cleft ϵ was traced from the N.W. wall of d, in which it makes a very distinct notch, to the ϵ side of a crateriform object V, traversing on its way the craterlet m. Commencing on the N.W. side of the small crater E and proceeding towards the N.W., a third cleft, η, was noted as very delicate. A fourth cleft θ, originating apparently at the craterlet f', was traced across the last, and, after passing through the object c, seemed to terminate at v. A probable N. extension of this cleft (also marked θ) is shown extending to the mountain mass, Gassendi a; but it is not clear whether it does not belong rather to the cleft E. The fifth cleft, ϕ, was observed from Mersenius g almost up to the well-known spur which projects from the S.E. wall of Gassendi. Mersenius g, f, and the craterlet f' are connected by a prominent bright ridge which stretches in a bold sweeping curve towards the N.W., and the cleft ϕ runs at the bottom of a shallow valley on the E. side of it—one of the few instances on the moon's surface of such a close connection between a ridge and a rill. This ridge is prolonged on the S. side of g (but without its accompanying cleft) and forms the E. boundary of a kind of bay in the Mare Humorum, very similar in character to Doppelmayer, and, like the latter, presenting all the appearance of having once been a complete formation. The dotted line h, h, h marks its W. boundary, which under oblique light is plainly indicated by a dark band much deeper in tone than the colour of the surrounding Mare. A low mountain, n, probably represents a portion of the original wall. Crossing this bay in a meridional direction is a distinct cleft, Doppelmayer ϕ, which seems to terminate where it touches the dotted line h. A ridge, 3, prolongs its direction towards the crateriform object Z. Another well-marked cleft cuts through the W. side of Z and ends on the E. side of a small bright craterlet s, which is surrounded by an ill-defined glow. A second ridge, 2, extends from this object towards the N., and a third ridge, 1, lies on the W. side of it. On the E. side of the ridge which connects g and f are two short clefts, δ, δ', which, having a common point of origin S. of f, spread out like the sticks of a fan to the N. wall of g. On the N.W. wall of Mersenius d is a delicate crater-rill which appears to commence at the notch referred to above as forming the S. termination of the cleft ϵ and, crossing the cleft θ at right-angles, to join the ridge and cleft ϕ at the point p. My diagram is on too small a scale to show this interesting feature properly; but it was very distinctly seen.



The instrument used was an 8½in. reflector by Calver, powers 350 and 400.

Thos. Gwyn Elger.

Kempston, Beds, 13th Oct.

THE WEATHER AND THE TIDES.

[21957.]—The effect of atmospheric pressure, both as regards magnitude and direction, in raising or depressing the level of the sea, and by consequence the heights of the tides which traverse it, is a subject of instructive interest and of much practical importance; and yet it is one which few care to investigate thoroughly, and one in reference to which there prevail very widely-extended misconceptions. A cursory acquaintance with the facts warrants people in asserting that "the tides are greatly influenced by the winds," and if by this expression is included and implied that which gives motion and force to the winds, namely, barometric pressure and direction and steepness of gradients, the statement has in it a considerable amount of truth; but a distinction must be drawn between the two effects. The tempest hurrying over the surface of the water has power to create huge foaming billows, to the terror of the mariner, and to that its surface action is limited; but the change in atmospheric pressure, which causes vast currents of air to slip as down an immense inclined plane, has power to alter the sea-level, and thus to produce on our coasts an increased or diminished range of tide. That this is the case will appear at once from the circumstance that very often the tide rises or falls beyond its predicted boundary when no storm is present at all, the only constraining force being the altered pressure of the atmosphere, as shown by the rise or fall of the mercury. It is perfectly true that in this respect the ocean is a water-barometer, and it is to be hoped that the time is not far distant when more attention will be paid to its indications; yet, in order that correct prognostics may be made, it is absolutely necessary that the normal height of the tide should first be correctly ascertained—that is to say, its height under specified atmospheric conditions. Twelve years' experience enables me to say that this can be done, and done efficiently, so that now an estimate can be formed within very approximate limits of the height which will be attained by any tide from the observed number of inches which were required to be added to or subtracted from the tabulated height of the tide immediately preceding. The meteorological aspect of the weather is perpetually varying, and a reference to the charts daily published by the Weather Office is most useful; but in order to get at a practical result, regard must be had to the actual deviation of one tide after another from the specified height, which belongs to a specified height of mercury with a level gradient. For example, I take four tides in succession correctly computed in the Admiralty tables for Liverpool.

Date.		Calcd. ft.in.	Obsd. ft.in.	Bar.	Wind.
1883.—Sept. 3.	Even.	26 9	26 9	29·9	slight.
4.	Morn.	27 5	27 6	,,	,,
4.	Even.	26 5	26 6	,,	,,
5.	Morn.	26 7	26 6	,,	,,
5.	Even.	25 6	25 6	,,	,,

In this case we have a steady barometer at the standard height and a level gradient. But now I produce results obtained with a barometer high, but steady, and pressure from the north, by which, therefore, the sea level is depressed; and it is seen how continuously that depression is maintained so long as the atmospheric conditions are stable.

Date.		Calc. ft. in.	Obsd. ft. in.	Error. in.	Bar.	Wind.
1883. Oct. 6.	Morn.	24 3	23 10	– 5	30·3	N. slight
6.	Even.	23 10	23 5	– 5	30·4	,, ,,
7.	Morn.	23 0	22 8	– 4	30·5	,, ,,
7.	Even.	22 10	22 6	– 4	30·5	,, ,,
8.	Morn.	21 9	21 5	– 4	30·5	,, ,,

Again we select from tides raised by atmospheric action, and the same persistence is still observed when the barometer is low.

Date, 1883.		Calcd. ft. in.	Obsd. ft. in.	Error. in.	Bar.	Wind.
Aug. 13.	Even.	20 0	21 1	+ 13	29·8	S.W. strong.
14.	Morn.	20 0	20 10	+ 10	29·7	S. ,,
14.	Even.	21 1	22 5	+ 16	29·6	S.W. ,,
15.	Morn.	21 2	22 3	+ 11	29·7	S.W. ,,

A curious circumstance which has been noticed repeatedly is this, that the sea rises several hours before the gale approaches; and yet this is only to be expected, inasmuch as the water expelled from one region of the ocean must at once bend its course to another, and all motion requires time for its accomplishment. On the same principle, at the season of equinoctial tides, the lowest ebb is that which occurs 2½ days before the highest tide, and not the ebb which immediately precedes or follows.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Oct. 8.

"PRACTICAL NOTES ON PLUMBING."

[21958.]—In reply to Mr. W. Fyfe's letter (21910), I have only to say that I have simply shown a distance pump, and for an illustration I have used the figures, say, 300 yards and 18ft. Here Mr. Fyfe has thought proper to take up quite an unnecessary line of argument for the simple reason that I have not in the slightest degree even hinted, otherwise than approximately, anything about the *proportions*, only as by way of an illustration, taking it *for granted* that anyone requiring such an engine or pump would employ a plumber of sufficient sense and skill to work out the machine in suitable proportion to that required. I contend that I have said sufficient in my articles to enable any intelligent workman to make the pump in question without my having to clutter pages away touching well-known details, and the whole body of physicks. What does it matter if I have not told my readers that the pump and pipes can be filled with a forcepump? Everybody capable of reading the article knows what a forcepump is, and also knows how to fill a pipe (*full too*, without having to resort to force pumps, and I, as a maker of the pump in question, say that such is not wanted; but let this stand. I will speak of the weighted plunger. Here, according to Mr. Fyfe's own writing, it is possible for such a machine to work, and I am certain that I have said sufficient to instruct any thoughtful mechanic. Have I not used these words—that it must be weighted sufficiently to allow for friction, and a fair allowance for putting the water into a *moderately quick motion!* Now, what would Mr. Fyfe have me to say? Would he have me give the weight of plungers for columns of water and pumps ranging from one foot to 100ft.? I contend that if I were to do so my readers would soon be very limited, and my articles (which I now consider too long) would never be ended.

Allow me to tell Mr. Fyfe that he has candidly confessed that the thing can be made to work, and he having seen in the article in question all I required my readers to see (I thinking that the other articles would be taken into consideration), he should not think himself better than others; for if he can work out this simple question as to the size of the plunger, &c., surely others can.

Some of my drawings would be pretty-looking things if they were all drawn to scale, simply because you would not be able to see many of the parts; besides, there is not the slightest reason for such work. The drawings are simply to illustrate the article, and never intended for measurements, nor have I even ever hinted such a thing.

With regard to the figures in No. [illegible], page 47, column 3, which I have not just at present at hand, the column should have been 60ft., not [illegible], and if printed as Mr. Fyfe states, there is not the slightest doubt but that they are wrong; but such a glaring mistake at once suggests itself, and any one capable of doing pumpwork would instantly see that it is a mistake, especially if they look at the figures above and below. The figures [illegible] if niceties are required, [illegible] would reckon 272·5lb. for a [illegible] and 326·30 for a 60ft. column, so that even Mr. Fyfe's figures (viz., "90lb. too much"), are not correct, although he has put it out as a [illegible] the above figures I can prove to be [illegible] yet there is a difference. Can Mr. Fyfe explain this enigma, and tell me where such hair-splitting would be of any practical use to the plumber who is satisfied with the reckoning ½lb. to 1ft. column of water?

Now refer to line 22, right-hand column, page 128 of his letter. He there refers to the suction water column not having time to stop. Why should I give "the exact conditions as to distance, depth, &c."? Sufficient it is for me to state that such is the case; that is, presuming that my readers are acquainted with the common laws of natural philosophy. Say that the column of water is drawn 18ft., horizontal distance of pipe to be 22: 22 + 18 = 40; say that its velocity is 1ft. per second, size of suction-pipe 1½in., which will at this velocity discharge [illegible] gallons per minute. Now, suppose the barrel to be 4in.; here the water travels at a speed of 1ft. per second; but suppose the perpendicular height to be say 4ft., and the horizontal distance to be 2ft., how work the handle of the pump, say, for argument's sake, so as to produce a velocity of 2ft. per second continuously, what time is there for the water to stop, clack to close, water to start, and clack to open? I have distinctly stated in my article referred to, that to effect a continuous stream, the handle must be worked (when giving the back stroke) very suddenly, like so many snatches. This, I consider should have been sufficient for any intelligent plumber's boy to understand, and why the question is here raised is past my comprehension. Speaking of momentum, I see there is a mistake by printing minute for second—this Mr. Fyfe has, I am pleased to say, pointed out. He also very kindly tells us that we cannot get a velocity of 6ft. per second through a suction pipe. I never said we could; but by way of illustration mentioned "a column of 40*lb. weight*, whose velocity is 30ft. *per minute* (which, of course, we all know should have been second) would, if suddenly checked, &c."

Now, with regard to the pump tables, Mr. Fyfe states that "they all refer to products above the hand, not a word on the tail pipes, or what part the atmosphere or friction plays in the matter." Now, with regard to the atmospheric work, allow me to say that the word "lift" of the water is what it signifies—simply the perpendicular lift from whence you bring it to the place where you deposit it, and I have said so in more than one place in my articles, which if I were to be continually repeating every time I have occasion to write upon the subject, I should have nothing else to do.

With regard to fractional parts, I have to say that they are not taken into consideration by the plumber when fixing a pump, nor is it in the least degree necessary for him to do so. Remember, I have allowed sufficient margin for everything, and that which is universally acknowledged by the trade as the working rule—namely, in a column of water 1ft. high, having the square inch for its base, I have allowed ½lb. This is sufficient for overcoming the friction in the vertical length of pipe, providing the sizes are taken into consideration.

We say that a column of water produces a pressure in pounds per square inch equal to about three-sevenths the height, or including the friction in the pipes it may be roughly taken at one-half. Thus a column of water [illegible] will produce about [illegible] [illegible] the temperature of the water, and, generally, for the exact [illegible] we proceed thus:—

A gallon of water at [illegible] weighs [illegible]. A cubic foot weighs [illegible] and contains [illegible] nearly six and a quarter gallons. Now, knowing this, it is a simple enough to get at the pressure of a column of water whose base is one square inch and height one foot.

A [illegible] working [illegible] water [illegible] square, will balance a column of water within a [illegible].

[illegible]

[illegible] Now [illegible] and say the pipe [illegible] through [illegible] which may be calculated by the following rules:—

G = ([illegible] H)

H = ([illegible])

[illegible] = ([illegible] H [illegible])

L = ([illegible] H)

In these rules D = diameter of pipe in inches.
H = head of water in feet.
L = length in yards.
G = gallons per minute.

Mr. Fyfe should know that, when writing articles suitable for the plumber, simplicity is the thing wanted, and I contend I have from time to time made my writings [illegible] suitable for the class of work that I [illegible] I [illegible] my works with algebraic rules and other formulæ requiring the use of [illegible]. Of course, Mr. Fyfe's [illegible] numbers in figures, &c., will always be appreciated by me, as the [illegible] can [illegible] than [illegible] but they would be more useful if given at the time.

P. J. Davies.

LIFE AND MATTER.

[21[illegible]]—Let us give a little further consideration to the dogma offered to us by "F. W. H." ([illegible], p. [illegible]), on the authority of Büchner, who appears to be regarded by him much as the orthodox do Moses or Paul, as he indicates that a quotation from him is to be received with the same humble acceptance as a text of those other authorities. Büchner, it appears, says, in "Force and Matter," p. 185: "Now in the same manner as the steam-engine produces motion, so does the organic complication of force-endowed materials produce in the animal body a sum of effects, so interwoven, as to become a unit, and is then by us called spirit, soul, thought."

Well, if the action of the steam-engine is to explain that of a living thinking man, we must needs first ascertain, *What is a steam-engine?* Is the steam-engine merely an organised mass of matter, iron, brass, &c., vitalised, so to speak, by the steam which conveys to it the energy of the fuel? This is a fair analogue of the animal body converting the energy of the food. But is this all that a steam-engine is? Not by a very long way. How came that "organic complication of force-endowed materials," the steam-engine into existence? Did its parts frame themselves by ever so prolonged a course of evolution? That its present construction is the result of long and gradual evolution we know; step by step it has become more and more complex, its action more and more automatic; just so has man, if we trace his evolution to that ancient marine ascidian, or even further back to a primary amœba. But—was the evolution of the steam-engine from within? *Was it the result of the actions of the matter and the forces which constituted it at each stage of its development?* Where is the "great German scientist" who dare ask us to accept the monstrous notion? and why are we to accept the same idea as to the man, which he tells us is constituted in the same manner as the steam-engine?

The steam-engine is the embodiment of the will and thought of its designer; these—not the matter and the force—are its ultimate source: they are its origin, not its product. But let us go a step further in our inquiry. "What is a steam engine?" The *engineer and stoker are essential parts* of the steam engine, as constituting a complete agent. Their controlling power was taken into account by its designer, and is essential to its working. That "unit which we call spirit, soul, and thought" is to the man just what the stoker and engineer are to the steam engine: if we can truly say that "the organic complication of force-endowed materials produce" in the steam-engine the unit we call the engineer, then—and not till then—we may say the same of that inner agent which all the wisest of mankind have agreed to consider is the true man—the spirit acting through the body.

And so of all life. Never have we yet seen matter and force constitute a living organism. Every supposed case of self-generated life has been traced to blunders of the observer, and not the most ultra-materialist dare assert that non-living matter has become living, except through the action of a living organism, much as he may long to do so. In the face of this, it is not within the lines of justifiable hypothesis to talk of the possible "synthesis of life." When Mr. Grey says to me, "It may not come in your time or mine, it may not come for centuries; but it *might* come to-morrow," I might, with equal propriety, use the same words as to a proposed excursion to the moon. Such an excursion is conceivable: an eminent scientific writer (Jules Verne) has even shown us a mode; still I do not expect ever to make one of the party; but I am quite sure of one thing, that such excursions will be as common as trips to Egypt are now, ages before the first synthesis of life has been effected.

It is very natural for uninstructed people to say "Oh, but you cannot limit the powers of science." But Mr. Grey ought to be above such clap-trap as that. We do know well enough some of the limits of scientific possibilities, and he must know that the step between the organic product and the organised being is so vast as to be nearly infinite; nothing bridges it but the imagination of the materialist who wants nothing but his own presumption to found an hypothesis on.

Organic chemistry may be independent of life; that is to say, we may produce organic substances direct from their material elements. I am quite ready to admit that some day we may make sugar from carbon, hydrogen, and energy; but sugar is a crystalline substance, a product of vital processes, not organised or living. We might make a good silk fibre for all I know; the silk fibre is not organised, it is a viscous substance collected by the worm, and mechanically spun out, just as we make lead pipes by the hydraulic press; we can dissolve silk, and, no doubt, could respin it. We can also dissolve cellulose, say, cotton fibre, and, no doubt, could from it reproduce *a fibre*, but not a cotton or a linen fibre, because these are organised structures; so we might make cellulose itself, the chemical substance, yet be no nearer the formation of a single cell, such as "life" builds out of it.

Have we not, then, the right to conclude that there is some absolute distinction between living matter and non-living matter; or, more truly, are we not bound to admit this by the necessity of honest reasoning? And this applies not only to the human life—endowed with thought, to the animal life—possessed of volition, but also to vegetable life, to the hyacinth bulb, and the ultimate cell capable of subdivision and reproduction. If it is said, by way of reproach, as Mr. Grey has said, the mystery is "not rendered one iota more clear by the assertion that life is a principle differing entirely from matter," I submit that the reproach is unmeaning. I have started with the admission of an unfathomable mystery, before which all wise men and all true science stand silent, in conscious ignorance. But are we bound to have *no mystery?* Are we to invent make-believe explanations, in order to pretend that we understand all things? Say that thought is a motion of matter, that life is a function of matter and energy, that spirit is the result of organic complication of force-endowed materials. What are all these but *forms of words without a meaning?* Do they assist anyone to form an idea of the things themselves? Truly we may say of those who thus wrap up their ignorance in sounding phrases, "Who is this that darkeneth counsel by words without knowledge?" Surely it is truer wisdom to accept a mystery, than pretend to explain it by a form of words conveying no ideas.

For, let us look at this a little closer. That hyacinth bulb, for instance. Why does it develop into a plant? A child might answer, Because God made it to do so; the "great German scientist" might answer, Because it is an "organic complication of force-endowed materials," whose potentiality tends by inherited development to that result. It sounds wonderfully learned, but the scientist's answer, like the child's, means exactly this: it does so because it does. But the child's answer has the advantage of being a humble admission of ignorance, the scientist's is a claim to pretended knowledge—the very worst sort of ignorance.

A great deal of the difficulty surrounding the conception of life is due to our habit of regarding each thing as an isolated individuality. We do the same in physics: in this latter case, however, true science recognises that there is no such thing as an isolated object. Everything everywhere is connected; gravitation binds the universe into one whole, in which every part influences and is influenced by all the rest; light, heat, sound, all the radiant forces are for ever transmitting energy from point to point, so that we may compare the atoms of matter to objects floating in an infinite ocean of energy. Extend the same conception to life, and we may realise that each individual life is not a complete and isolated unit, it is but a cell, a leaf, a flower upon the tree of the infinite life whose streams are the source of its own vitality.

There are four theories of existence which include all the possible doctrines of life.

1. The Lucretian idea of the fortuitous concourse of atoms, drifting endlessly through space, uniting, by mere collision and propinquity, to form the universe.

2. The Gnostic conception of a creative spirit acting on an opposing self-existent matter.

3. The common orthodox notion, very definitely expressed in the Westminster Confession of Faith, "it pleased God . . . . to make *out of nothing*, the world and all things therein."

4. The Vedic doctrine that the infinite, self-contained and all-containing one (implied by their "Om" as also by the "I am" of the Jewish scriptures), "willed to create various beings *out of his own divine substance.*"

It is the first of these which is sustained by such writers as Büchner and other pure materialists who endeavour to convince us that thought, consciousness, and will can arise out of the association and conjoint actions of material atoms having no consciousness or will. This is the school of the purely materialistic evolutionists.

The last is more like that of those evolutionists who recognise the utter incomprehensibility of nature and existence apart from the action of mind and will. They see that the "organic complication of force-endowed materials" of the other schools needs the controlling engineer to make their action conceivable. To them, life, soul, thought are not an incomprehensible product of matter and energy, but an agency superadded to matter and energy, which carries these out of the non-vital domain of physics into the higher order of metaphysics. It is because the so-called science of metaphysics is an attempt to describe and define that which is by its nature beyond our comprehension that it has become a mere wilderness of verbiage.

I had written thus far before the appearance of No. 969, several of the letters in which are thus answered in anticipation. "F. W. H." (21936, p. 150) endeavours to explain Büchner's steam-engine ideas, but his explanation will break down. He says that the meaning is, that "as the engine produces motion, so does the brain produce thought." Even so, that gives no proof that thought is motion. I know that the brain *produces* thought, and must ask "F. W. H." to endeavour to seriously understand what this means in two distinct lines: What is the brain? You see the whole question is begged in comparing it to the steam-engine. We know that by the steam-engine Büchner means the merely physical association of matter and force; but the brain includes the agent about which we are debating, that agent which I have compared to the engineer. But there is a more fundamental distinction: the *steam-engine does not produce motion;* it simply transforms motion. It *produces* nothing; it only directs and applies pre-existing energy to a purpose controlled, as to manner, by the purpose and will of its designer; as to time, by the purpose and will of its engineer—purposes and wills working through, but independent of, the organic complication of materials. But the brain *produces thought*; it possesses a creative power in no way comparable with any action of the steam-engine, or with any material action.

Energy is not matter; energy is not even an action of matter. It appears conceivable only as something impressed upon matter, intelligible only as an effect of will. But energy is conceivable only as manifested in connection with matter. It is motion, and though mathematicians do talk about "pure motion," it seems impossible to conceive of motion except as connected with something moved. Yet we can clearly distinguish between matter and motion, and conceive their separate properties and actions. We can conceive matter *per se*, and apprehend the change in its actions when energy is superadded. But the actions of life involve just such another different set of functions, exerted by combined matter and energy, which it is more reasonable to attribute to a fresh agent than to some latent function of their own which only comes into action in the form which we call life, and which every evidence we have proves cannot come into play spontaneously.

Let us give what functions we may to the ideal matter, we have to explain what sets this function of "life" into operation. We only put the difficulty a little further out of sight by attributing life to a function of matter itself, instead of to some agent as distinct from both matter and energy, while dependent upon both for its manifestation, as energy is from matter. The quotation from Haeckel in like manner begs the question; he says, "Our soul life is indissolubly bound up with the organisation of our central nervous system." He does not know that; by no effort of reason or experiment can he prove it. All that he knows is that his soul life does actually perceive its relations to matter and energy through his nervous system; that they are "indissolubly" united he simply *thinks*, just as all the religious ideas of mankind are based upon the *belief* that they are united only for a time and capable of separate existence. Neither the belief nor the thought can be proved or disproved except by the evidence of the separate existence, and such evidence the nervous system would be incapable of perceiving. The very assumption of the separate soul life implies its being out of the range of mere matter and energy. Once we have entered upon this line of thought it is easy enough to see that animal life and human thought may each be successive stages of existence due to the adding of a new agency to those which constituted the lower.

If proof is asked, none is possible. It is all a matter of reasoning from imperfect evidence. It is simply a question. Can we best account for incomprehensible facts by attributing these effects to distinct agents of which we know nothing but their actions, or to functions of a something which we call matter, but of which we equally know nothing but its actions? When we are told "the soul of the plasticule would therefore be the ultimate factor of the organic soul life," how much have we advanced towards understanding the matter? What is the soul of the plasticule? Does it not come to the same thing as that which the other belief calls "life"? Does not Haeckel himself see this when he says "All organic matter at least, if not matter as a whole, is in a sense gifted with a soul"? The distinction between this and my own statement of the case appears to me very slight. I have never pretended to explain, for instance, how the individual human soul is constituted. I think it probable that it, too, grows out of its proper elements concurrently with the body, which may be, for all I know, the agency of its growth.

"Lamplighter" (21937, p. 150) introduces an entirely distinct thing. Clairvoyance, so-called, has nothing to do with the subject of transfer of thought, except that clairvoyance is probably only a misconceived effect of transfer of thought; at all events, I have always found it to be so. No one professes experiments on the transfer to be of any *use* except as enlightening us upon the nature of thought and existence. But that is a matter of supreme importance.

When Mr. Craven (21938) has anything to say that he appears to understand, or wants information to enable him to understand anything, I shall be glad to listen to or help him. But he must excuse my paying no attention to such remarks as he is in the habit of making on these subjects. Sigma.

LIFE AND M

[21960.]—I am quite of
almost enough has been
therefore, only reaffir
may prevail. It is
to call the conclusi
other scientists of
and illogical";
aspersed, but pos
is stranger than
when it knock
ideas and p
"Sigma"

"entity," but I must demur to his statement that he said nothing as to the nature of thought or mind. It is on record in your valuable journal that "Sigma" calls "mind" an entity, who works with the senses like a workman with his tools, and I must really be excused if I took that to be an explanation of the "nature" of mind.

"Sigma" is acquainted with electricity; now, if he composes a "battery" of certain elements placed together under certain conditions, does not here "mere matter" produce a "force"? Will he call this "force" an "entity" or agent working with the "elements"? Remove the necessary conditions or displace the elements, electricity disappears or ceases to act. Is it unreasonable to suppose or conclude that mind or thought is a similar "force" or "energy" resulting from the action of living brain, perhaps by the assistance of electricity under the necessary conditions, which also disappears if brain matter is destroyed or the conditions altered? Does not a piece of wire (mere matter) with the assistance of an electric current become capable of transmitting the human voice a thousand miles?

Büchner says, "Force and Matter," page 187: "Electric currents constantly surround the nerves when at rest. These currents cease, or become weaker, whenever the nerve is excited to activity. The nerves, therefore, are not the conductors but the generators of electricity. This generation ceases with the activity of the nerves, that is, with sensation or the exertion of will. Psychical activity accordingly was, by some, defined as latent electricity, and sleep as a relaxed function of the electrical nerves! Experimental inquiry may, perhaps, lead us to a more intimate knowledge of psychical functions."

Nothing is ever gained by pronouncing a mere "non possumus," by saying this "must" ever be unknown! In that way all act of inquiry for "truth" has always been opposed.

The wisest and best authorities may be entitled to our greatest respect, whether ancient or modern; but let us also not forget that some of the wisest and best are known as such "now" only to their posterity, and that Galileo was made to recant on the rack his opinion that the earth moved, "by the wisest" and best of holy Inquisitions!

F. W. H.

[21961.]—In letter 21934, "Anglo-Dane," after speaking of cell-divisions, makes the following statement:—"I am fully aware of what forces are in operation during the growth of the cell. I am certain we can produce artificially all the conditions of matter and force which are present and active in the growing of the cell." The calm assumption of knowledge is astonishing to anyone who knows anything of the subject. As a chemist and a physiologist, I would caution readers of the "E.M." against accepting such an assertion as at all expressing the views of scientific men. At present the chemical composition and structure of living protoplasm cannot be ascertained. We know that certain substances (albumens, salts, &c.) can be extracted from dead protoplasm, and certain empirical formulæ have been proposed as representing the ultimate composition of dead protoplasm; but of the arrangement of the atoms of the different elements nothing is known. Those who know how wonderfully the properties of a substance are altered by changing, even slightly, its atomic arrangement without altering its composition, will see how far at present the physiologist is from a knowledge of the chemistry of life.

With regard to the forces actually at work as little is known. For example, the unicellular organism, the amœba, requires oxygen for the performance of its functions, and there is no doubt that it eliminates carbon dioxide, so that it is an animal; or, in other words, there is a running down of energy. But what particular form of force the energy, produced by the combustion of the carbon of its tissue, takes, it is impossible to say. We may assume that the ultimate form is heat; but it is the intermediate form, or forms, that it is important to determine.

With regard to the second sentence above quoted, it must be obvious to all that if we are so great a distance from the comprehension of the constitution and forces of living matter, we cannot be in a position either to artificially imitate them, or to predict or deny the possibility of their imitation in the future.

E. F. H.

TRANSFER OF THOUGHT.

—Since the discussion has turned aside to
bject of the nature of thought "Sigma"
fortunate. The wide gaps in his
noticeable, as in the earlier
he argued with a clear
with facts, and held

ling light on the
109, where he
and mind
"what

known (p. 39), and he has already spoken of the existence of this extra-material principle as a "truth" (p. 39), and a "fact" (p. 66).

Now the only possible inference is a startling one, viz., that here is a fact and a truth that are not within the domain of science, nay, more, that this fact and this truth are not to "be known." In what way are we to describe, how can we characterise, a fact and a truth which are unknown? Of course, there may be facts and truths which are not now, and will be never known; but who then will say that they are facts and truths, and if anyone will foolishly venture to say so, what possible evidence can he offer as to facts and truths unknown and unknowable to enable us to judge whether they really are facts and truths? Then there seems to be no escape from the conclusion that "Sigma" is entirely ignorant of this fact and truth, and that therefore he is one of those "people who talk about what they know nothing about" (p. 29), and "asserts as a fact what is nothing but a notion based upon his own presumption and ignorance" (p. 66).

Science is what we know, and as there can be no fact recognised as such until it is known, science includes all facts, and immediately a supposed fact appears it is the special province of science to investigate and determine whether it is indeed a fact, and can be added to our sum of knowledge. This is what science has to do with the matter. If, though, science, as "Sigma" defines it, has nothing to do with the question, then the question relates merely to a notion, a speculative exercise of the imagination, and to no fact. To hold an opinion about what is, according to "Sigma," unknown and unknowable, surely is sublimely ridiculous.

"Sigma" is only just when he says (p. 39), "it is like the presumptuousness of children when the anatomist denies the existence of some higher principle." All that the anatomist can fairly say is that there is no ascertained fact, no known course of reasoning, no available evidence, which points to the existence of any principle other than may be involved in the existence of matter.

According to Moleschott, thought is a motion of matter. "Sigma" replies to this by accusing Moleschott of presumption and ignorance. He admits, however, that thought is accompanied by certain motions of matter, seemingly as heat is. Then it is certain that there is a causal connection, and either thought and heat are causes of motions of matter, or certain motions of matter cause the phenomena of heat and thought. When we see that certain phenomena and certain motions of matter are contemporaneous, what do we decide—that the phenomena cause the motions, or that the motions cause the phenomena?

W. A. L.

MATTER AND THOUGHT.

[21963.]—When one hears that vital force is a nonentity and that the brain thinks, one cannot help asking, if this be so, what, then, is the cause of the wonderful difference we know so well to exist between the living and the dead? Again, if thought is due to the motion of brain matter, what kind of motion is it? Motion cannot entirely cease in the brain at death—the chemical forces must prevent that from being the case. Is the motion so induced thought? If not, what constitutes it? But why should I conclude that the motion of matter within the brain is thought, any more than the matter in motion without the brain which conveys the ideas of one speaker to another is thought? In a vacuum there could be no transfer, and apart from a material organisation, no manifested thought. It has always appeared to me that the law of the conservation of energy is fatal to a materialistic explanation of thought. It may be supposed that this law holds good of the physics of the brain as elsewhere, and when the physical equations are satisfied, there is no energy left to convert into thought. It is motion plus thought. Instead of saying that thought is the result of matter in motion, it is far more tenable to say that thought *is* matter in motion. But is this materialism? Why, it abolishes matter by converting it into mind—all physical facts are mental facts. We are landed in idealism pure and simple.

It is generally admitted that idealism cannot be proved to be false; but if we are to hold by common sense, which idealism dispenses with, and to retain the notion of matter at all, we are attributing to it a property which we do not know to belong to it. What we do know is, that mind is associated with a particular kind of matter only for a time, and that the connection, once broken, can never be re-established.

Mind is so opposed to matter in all respects, that we should require good proof indeed of its not being something *ab extra*.

J. A.

THOUGHT READING AND GIRL'S LOVE OF ADMIRATION.

[21964.]—I am a young Irish girl, just sweet *16, and I beg* leave to protest most emphatically *against the assertion of "F.R.A.S," who, in letter* 21898, page 25, says "the love of approbation and admiration is so innate in all girls that they will do anything to win it." There is at least *innate* evidence in this paragraph that your great scientist knows nothing at all about girls. I am sure he is a cross, crazy, pre-occupied *fellow*, who is for ever impaling spiders on his microscope and mooning through his big telescope—an implacable old grey-bearded astrological wizard, who knows far more about the horrid old woman rolled up in a blanket than he does of a dear, sweet, darling little girl dressed in inimitable fashion, and wearing the "latest thing" in sealskin hats. I can tell "F.R.A.S." that no girl, young or old, would act those deceitful things. Who ever heard of a *girl* going on the stage at the invitation of any conjuror or mesmerist, sticking the leg of a chair into her mouth, flapping her elbows, or capering around the stage, trying to make us believe she felt herself bewitched into a Highland piper? These and other follies she leaves to "F.R.A.S.'s" boys, whether gutter snipes or nobles. I will not here say what a girl can do besides dressing to win admiration; but I will tell "F.R.A.S.," until he leaves the cold, distant, stars of heaven to consider the near, warm stars of earth, he shall have no admiration from me. As for reading a young girl's thoughts, "Sigma," "F.R.A.S.," or any other man may rest assured that is all moonshine!

A Limerick Girl.

SECOND SIGHT AND TRANSFER OF THOUGHT.

[21965.]—While the subject of transfer of thought is "to the fore," I should be much obliged if you, Sir, would spare me space for a question or two on the above-named subject. I should much like to hear "Sigma's" opinion of the phenomenon called by the Highlanders *Taishitaraugh*, or second sight, which consists, I believe, in the faculty of perceiving persons engaged in actions either future or taking place at the time, but unknown to the person witnessing them. Were I to ask for instances, I have no doubt your readers could fill me a whole No. of the "E. M." with what they have *heard or read*; but can any of them tell us anything as satisfactory as "Sigma's statements regarding transfer of thought. He says simply, "I have done it." Can any among your countless readers state *that they themselves have seen* any unaccountable appearances (for want of a better term), whether confirmed by subsequent events or not? It seems to me that the faculty must have some kind of connection with transfer of thought, if such faculty exist; but first let us have some proof of its existence.

Charlie.

EXTRAORDINARY MESMERIC SLEEP.

[21966.]—Knowing that, in the interest of science, the "E.M." is always happy to insert general information for the benefit of its numerous readers, I have taken the liberty to inform "Sigma" and others that, having heard of a case of very prolonged sleep, I, last Friday, left Edinburgh on a visit to the Glasgow Western Infirmary to see the patient, and have had that satisfaction. By Dr. Cameron, who (under Dr. Gardiner) has charge of the case, I was very courteously and kindly received, for which I thus publicly thank him. Dr. Cameron gave me the Ward Journal to read up the case, at same time informing me that the patient is a Highland woman from the Island of Skye; that she is married and has three children; that her name is Mrs. McInnes; that she is 35 years of age, and has been for over 18 *weeks* in *one continuous sound sleep*, from which she has *never once wakened*. In this state she lies on her back and never moves a muscle. Her pulse is 80, her breathing fair, and, to keep up her strength, is fed three times every day by means of the stomach-pump apparatus. Now, however others may reason or speculate on this extraordinary phase or phenomenon of suspended power, to me it is a singularly clear case of true *natural* trance, usually called *deep mesmeric sleep*. My explanation of it is that, from some *requirement* of the animal economy, the patient yielded obedience to the *call to sleep*; that, *conditions being favourable*, the *tendency to continue the rest prolonged* the period of ordinary waking; that the over-solicitude of friends *interfered* with the natural sympathies of the system *to recover itself*; and that this *outside* pressure on an extremely sensitive, high-pressed nervous system, very likely brought about by well-meant but ignorant tampering with delicate bearings, produced an *outrage* of the great *natural* law of toleration, which ended in the breaking of the balance between the sensory and motory nerves. From suggestions which are being acted on, there is some hope of nature recovering herself. Meantime, the lesson is suggestive enough of many things; and, although "one swallow does not make a summer," it appears to me that *one fact* of this kind is worth more to *science* than a shipload of arguments would be against it. **J. D. Morrison**, Surgeon-Dentist.

27, Grange-road, Edinburgh, Oct. 17.

THE PANAMA CANAL.

[21967.]—The only comment necessary on letter 21952, p. 155, is, May the Editor and his readers live until the Atlantic and the Pacific break through the isthmus! Tithonus, however, reminds me that it is to be hoped they won't grow any older, for if they do, how terribly old they'll be! It may interest your readers to learn that M. Dingler, the chief engineer, is convinced that locks will be necessary for the following reason:—At Colon, on the Atlantic, the difference between high and low-water mark is not more than 58 centimetres (23in.), whereas at Panama, on the Pacific the average variation in the height of the water is 4 metres (13ft. 3in.), and is sometimes as much as 6 metres (19ft. 8in.) Moreover, high water at Colon is about nine hours later than at Panama, therefore half tide at the one place corresponds with the flood or the ebb at the other, and there may be a difference of tide level between the ends of the canal equal to half the rise on the Pacific coast. By comparison with the canals and rivers which empty themselves into the Bay of Biscay, M. Dingler estimates that the speed of the current would be from five to six miles an hour in the uninterrupted portions of the channel, and greater when the cross section is reduced by the passage of a vessel. It would, therefore, be impossible to use the canal in one direction, and very dangerous to do so in the other, so he concludes that to enable vessels to enter and leave the canal at all states of the tide it would be necessary to build locks at the Panama end, and he proposes to establish there, one for entrance, one for exit, and the third to be used when either of the former are under repair. If the locks be not made, it will be necessary to slope the bed of the canal from Colon to Panama, cutting it two metres deeper at the latter end, and this would require the removal of 10,000,000 cubic metres of soil, at a cost of 45,000,000 francs. The lock would cost 11,500,000 francs, and thus by their employment, a saving of 32,500,000 francs would be effected.

Besides the reasons pointed out by "Sigma," p. 15, there need therefore be no fear of the Gulf Stream wasting even a portion of its strength on the Pacific.

Nun. Dor.

CONTINUOUS BRAKES.

[21968.]—Seeing in last Friday's "E. M." a letter by "Imprimatur" on the Parker-Smith screw brake, I should like to say a word or two with regard to his letter. He remarks, with reference to the Westinghouse brake, that fatal accidents have occurred owing to the brake applying itself automatically. Why he says this I cannot understand, seeing that the Parker-Smith brake is itself automatic. "Imprimatur" is wrong in saying that to release the Westinghouse brake, after it has applied itself automatically, takes 10 to 15 minutes. I have seen it done on the North Eastern Railway in *less than three minutes*—a very different matter. Again, if a fatal accident occurs owing to the above cause, it is the fault of the signalling department, and not of the continuous brake in use. It is far better that the brake applies itself automatically than that it gives no indication of a failure, so that when the brake is urgently needed there is no brake power available. Again, the chain connection is not so good as "Imprimatur" thinks. The chain connections often break; indeed, I have often seen trains on the L. and N.W.R. running, with the broken portions of the chain rattling about in the four-foot.

If the brake-blocks of the Parker-Smith brakes are normally on, does not this impede shunting operations, when carriages are uncoupled? And, granting that there is an arrangement for preventing any delay arising from this cause, by which the brake-blocks can be *kept off* the wheels, will not this arrangement interfere with "Imprimatur's" practical test that the brake is in proper working order when the train starts? By this I mean that, supposing a train has been made-up and shunted down to the platform ready for starting, in these shunting operations this arrangement will have to be used. It can, therefore, easily happen that the shunters forget to restore the brake to its normal position, and if all the chains are not connected, the train may start with only a portion of the brake-power available. In this case the driver cannot tell that anything is wrong, because the brakes will *not* go on. "Imprimatur" gives the parallel case of the Westinghouse, in which the taps between the carriages remained unopened. But the rear guard, by looking at the gauge fixed in his van, can easily see if the train-pipe is completely charged with air or not.

But "Imprimatur" has forgotton one of the most important characteristics of a good brake—viz., the brake-power. The P.S. brake is applied by the slackening of the connecting chain, which allows weighted levers to fall, and thus the brake-blocks are forced against the wheels. I very much doubt whether the falling of a weight can produce enough brake-block pressure (30,000lb.) To produce any considerable amount of pressure, the weights must be exceedingly heavy, and have a very large leverage.

This is a serious defect in mechanical brakes—viz., that pressure enough cannot be produced. Another serious defect—as experienced both in England and on the Continent—is that the brake connections (whether rod, screw, or chain) are liable to be clogged up with dirt and dust, and frozen up in winter.

I should like to see the results of a trial of this brake on a train of from 15 to 20 carriages, and until it has proved itself thoroughly satisfactory in such a trial, its merits must not be compared with those of a brake which has stood thoroughly practical tests. Let "Imprimatur" remember that he is advocating an untried brake, and also let him remember that simplicity is not always a merit. I agree with him in hoping that Mr. Parker-Smith will give us a description of the brake, with drawings, stating how he attains the necessary qualities belonging to a good continuous brake. In conclusion, I add that I am a totally impartial observer of the brake question, and only wish for the best appliances for insuring safety on our railways.

Oct. 18th. **Meteor.**

CONTINUOUS BRAKES — THE ACCIDENTS AT PERTH, CARLISLE, AND LOFTHOUSE.

[21969.]—Major Marindin's report upon the collision which occurred at Perth on the 28th July has been published, and contains some important information. An East Coast train from Edinburgh was standing at the ticket platform, Perth, when it was run into by a West Coast Express from Euston; this latter train was composed of West Coast vehicles (the joint property of the L. and N.W. and Caledonian Railway Companies), and was fitted with the Clarke and Webb chain-brake of the newest pattern. This brake is *supposed* to be under the control of the driver by means of the cord; we know that drivers have many times stated that they could not get the brake to take effect; but the true state of the case has not before been officially brought to light.

Major Marindin made some practical experiments with a train made up exactly like the one in question, with the identical brake-van. He reports:—"It is an absurdity to talk of a patent chain brake at the rear section of a train of ten vehicles being under the control of a driver by means of the connecting cord, if by control is meant the power of applying the brake. The utmost a driver can do, even with the assistance of his fireman, is to pull the lever about 7½in. up the quadrant, which is not sufficient to cause the brake-block to rub against the wheels." He also states: "Such a machine is nothing but a trap; and following so soon after the terrible disaster at Lockerbie, hopes it will cause the Caledonian Railway Company to insist upon having the West Coast Joint Stock fitted with the brake which they have adopted."

The above statement of the danger of the chain brake is very clear, and must make every one feel more and more the injustice done to poor driver McCulloch, who was actually sentenced to four months' imprisonment because he could not apply the emergency chain brake at Rutherglen. It is satisfactory to find that the Caledonian Company has "insisted" on the West-Coast Joint Stock being fitted with the Westinghouse Automatic Brake, and now the Great North of Scotland Line has adopted the same system, there will be no further trouble with regard to interchangeability of rolling stock in Scotland, especially as the Midland Scotch Joint Stock has always had this brake; the East Coast has the connecting pipes, and the West Coast is now being fitted with the brake, some of the carriages being already in daily working.

Major Marindin also presents his report upon a collision which took place at Carlisle on the Citadel Station Joint Committee Line. On the 13th August, a return North-Eastern excursion train, drawn by a London and North-Western engine, came into collision with a light engine. The report concludes:—

"The accident might easily have been prevented if the driver of the excursion train had had a continuous brake at his command; but, as is too frequently the case, owing to the various classes of brakes in use upon different lines, the Westinghouse brake with which the carriages were fitted was useless so long as the train was drawn by a London and North-Western engine. It will sooner or later become a question for very serious consideration, whether stock should be allowed to be transferred from one line to another unless means are provided for utilising the brakes with which it is fitted, and which are necessary for the safety of the passengers."

The collision which occurred at Lofthouse Station on the Great Northern Railway, on the 15th September, is another instance of the danger which follows the use of slowly-acting non-automatic vacuum brakes. Here was a short passenger train consisting of only engine, tender, and seven vehicles running at twenty to twenty-five miles an hour, up a gradient of 1 in 100, yet all the vacuum continuous brake could do was to reduce the speed to about fifteen miles an hour in forty to fifty yards. If this train had been fitted with an efficient brake, the collision might have been rendered harmless, or, perhaps, entirely avoided. The moment the collision took place the Smith's vacuum pipes were broken and the brake rendered useless, and passengers have informed me they were more injured by the "sharp recoil" of the carriages than by the actual collision. It must be remembered that with an automatic brake no recoil can occur, thus preventing this cause of danger to the passenger.

Clement E. Stretton.

40, Saxe-Coburg-street, Leicester, October 20th.

RAILWAY SPEEDS.

[21970.]—I have been waiting patiently now for some months, hoping that some "Railway" correspondent would kindly favour the readers of the English Mechanic with particulars of the Duke of Edinburgh's "special" from Leeds to London, mentioned briefly by "C.R.M." in No. 935 of the "E.M." (p. 571) as having done the distance in exactly three hours. If this statement be correct, this is the best run on record on either Broad or Narrow gauge, and details of the performance would be most interesting.

By the way, I had a splendid run on the G.N.R. on the 4th of this month in the train due to leave Peterboro' 1.38, and arriving at King's Cross 3.15. The train was late, and did not leave Peterboro' until 2.2, and arrived at Finsbury 3.25. The engine was No. 92 (Doncaster, 1870), 7ft. 6in. single, cylinders 17½ by 24, with inside bearings to driving, and outside to leading and trailing wheels.

The train consisted of 10 or 12 carriages, I forget which. I give a list of speeds taken, but was most occupied in checking individual miles:—

	10¼	miles in	15	minutes	= 41	m. per hour.
	15	,,	15	,,	= 60	,, ,,
	7¾	,,	8	,,	= 58⅛	,, ,,
	9	,,	10	,,	= 54	,, ,,
	8	,,	10½	,,	= 45$\frac{5}{7}$	,, ,,
	23¾	,,	24½	,,	= 58$\frac{8}{49}$	,, ,,
Total	73¾	,,	83	,,	= 53$\frac{3}{10}$	,, ,,

The speed for individual miles was frequently 65½ miles per hour, and on one occasion at least reached 72 miles per hour, the last few miles being done very fast indeed.

October 20th, 1882. **St. Aubyns.**

THE NEW STANDARD WIRE GAUGE.

[21971.]—I send you inclosed a copy of the decimal equivalents in parts of an inch of the new legal standard wire gauge, also in line with them the decimal numbers approximating to the old Birmingham wire gauge (B.W.G.).

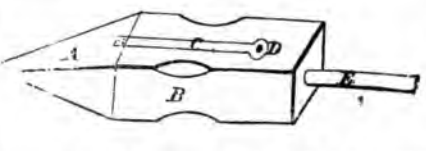
The new gauge runs very nearly with the present Lancashire wire gauge, and if adopted, the old B.W.G. will be "a thing of the past."

Descriptive Number B.W.G. No.	Equivalent in parts of an inch.	Old B.W.G.
7/0	·500	·500
6/0	·464	·465
5/0	·432	·430
4/0	·400	·400
3/0	·372	·375
2/0	·348	·350
0	·324	·325
1	·300	·300
2	·276	·275
3	·252	·250
4	·232	·230
5	·212	·210
6	·192	·190
7	·176	·175
8	·160	·160
9	·144	·145
10	·128	·130
11	·116	·117
12	·104	·105
13	·092	·095
14	80	85
15	72	75
16	64	65
17	56	55
18	48	50
19	40	45
20	36	40
21	32	35
22	28	31
23	24	28
24	22	25
25	20	22
26	18	20
27	164	18
28	148	16
29	136	14
30	124	125

Lestar.

AN IMPROVEMENT IN SOLDERING-IRONS.

[21972.]—As I am often troubled with soldering-irons being overheated, and the solder perishing in consequence, I made a copper cap (well tinned) which could be taken off when the iron required heating. Finding this contrivance answer exceedingly well, I thought the information would be useful to other amateurs who are troubled in the manner I have intimated. The following is a rough sketch of the iron, with the cap attached thereto. A is the cap; C is a strip of copper riveted on to cap; D is a hole in the strip, with hole in the iron corresponding; these to be fastened together with a pin, which can easily be removed when the iron requires heating. B is the iron; E handle.



Arthur R. Hallett.

Sturminster Newton, Oct. 15th.

MANDREL SCREWS.

[21973.]—I notice that your correspondent, E. R. Dale, in No. 968, requests the criticism of your readers on the mandrel screw figured by him. I will say, in my opinion, that it is the most sensible mandrel screw I have seen described in your columns for some time. The smooth cylinder at the left end of the screw I think is a decided, I do not say, improvement, but an absolute necessity. My own lathe mandrel has just such a one, and it is made by a first-rate London maker. In the drawing, however, the right end of the screw should be rounded off, and not cut square off as drawn. The cylindrical projection marked B, I think, would be very much in the way, and would afford no advantage whatever. I myself consider that Dr. Edmunds's thread of 10 to the inch altogether too fine, unless for a mere ornamental lathe, and that is a part of turning I have never had anything to do with. I think myself that you cannot improve upon the Whitworth thread of 8 to the inch for the mandrel screw, and I would make it for a 5in. lathe 1⅛in. in diameter.

Your very interesting correspondent, Mr. Evans, had several lathes at the exhibition at Islington in July last, and I particularly noticed a very nicely-made plain lathe, but with the mandrel screw 10 to the inch; and I am certain it is decidedly too fine for everyday use. One screw figured in your journal had the screw scooped out at the extreme left of it, thus making it weaker there than anywhere else, instead of stronger, which it of course should be.

C. A. T.

STYLOGRAPHS AND THEIR DEFECTS.

[21974.]—The stylographic pen is a great convenience; but no inventor seems to have succeeded thus far in making a joint which will prevent soiling the fingers with ink. A remedy for this leakage, which has been tried and thus far seems to be complete, is to rub the joint on which the fingers rest with the thin end of a piece of wax. Hold the pen over a candle, lamp, or the flame of a match, till the wax melts, when it will bite the lute so that no ink can escape through it.

Washington, D.C., Oct. 9. **M. C. M.**

THE BERTHON POWER GAUGE—CORRECTION.

[21975.]—Allow me to correct a numerical error in my letter, No. 21951, as it appears in your issue of to-day. The third measure in the column headed Gauge A corresponding to ·062 and ·014 in the other columns should be ·020, not ·120 as printed.

T. Perkins, M.A.

Shaftesbury, October 19.

REFLECTION OF LIGHT.

[21976.]—I should be glad of a few remarks from "F.R.A.S.," or other competent correspondent, on the following quotation from Tyndall on "Light":—

"The light which falls upon a body is divide
into two portions, one of which is reflected fr
the surface of the body, *and this is of the same*
as the incident light. Solar light reflected
surface of even a black body is whi
camphine smoke in a dark roo
sunbeam passes renders t
white by the light scattered
the soot particles."

Tyndall also says of
covered with the black
be white.

He then speaks of
entering some dista

being there robbed of some of its constituents, and re-emitted more or less changed in colour.

My difficulty is this: Is not this *second* portion that which is usually called scattered, or are there in fact *three* kinds of reflection?

1. Regular reflection according to the equal-angle law in general; no colour change.
2. Surface scattering in all directions; no colour change.
3. Partial absorption and re-emission in all directions with the so-called colour of the body.

Surely when Tyndall speaks of the moon as white by means of the first portion of light, he cannot refer to specular reflection. In fine, why is the moon white: if the moon were cased in red annel, what then? **L. S.**

LEGAL REPLIES.

[21977.] — Restraint of Trade — Covenant (51854).—This extract from the deed does not say whether there was any limit as to space, such as that the vendor should not carry on the said business within ten or a hundred miles. If there was no limit at all, then the covenant may not be binding; if there is a limit of space then the querist can manufacture beyond that limit. Presuming nothing is said about space, it would not do for the querist to carry on business so close to his old place, for he would probably be stopped by an injunction, and be sued for damages; supposing, of course, that the covenant is held valid under the circumstances. But if he went ten or twenty miles away, I should think he could sell his inventions as he proposes.

Married Women's Property—New Act—Title Accruing (52935).—This question raises the same point as was lately discussed in these columns between "Lex" and myself. Section 5 of the Act of 1882 gives to a married woman who was married before the 1st January, 1883, such property as that in which her title to it shall accrue after that date, and whether it be vested contingent or in remainder. In this case the title of M. to the legacy left her by S. accrued in 1837, when M. died. The legacy then vested, as we call it, in M., the legatee, although it was not to be paid until the death of the testator's husband. Under these circumstances I think M. does not take the legacy as her separate property under the Act of 1883; but that it will go to her husband when he reduces it into possession.

Right of Entrance and Way—Non-User (52020).—Non-user in a right of way, or any other easement, would not, alone, be conclusive evidence of its abandonment. But it is some evidence, and coupled with other facts it would help to support a defence that the right of way formerly possessed had been abandoned, and so lost. Non-user of a right of way for twenty years would certainly raise a very strong presumption that the right had been released; but so long a time is not in all cases necessary to arrive at the same result, and much must depend on the facts. As this querist has another entrance, his not using the one in question would not prove he meant to abandon it; at all events until after the lapse of a long time, which may be broadly put at 20 years.

Apprentice's Overtime (52023).—The indentures of apprenticeship should say what hours of work are to be required. The fact of a task being done would not enable an apprentice to do nothing more. If by overtime the querist means beyond the hours agreed upon, then the apprentice could not be compelled to work longer. Should nothing be said about hours in the indentures, then the apprentices must abide by the rules of the trade. The real question here seems to be rather the rate of wages than the hours of work.

Apprentices and Housework (52040).—An apprentice bound to a trade cannot be compelled by his master to do housework. His duties are limited by his indentures, and by the needs of the trade in which he is bound. An apprentice must obey his master, but is under no obedience to his master's wife. He can simply refuse to obey her orders, and leave his master to enforce such obedience if he can.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

HYDRAULIC RAMS WITH TWO PULSE VALVES.

[21978.]—With regard to "Glatton's" reply, letter 21908, I am glad to find that he has thought over the true meaning of "expend"; had he done so before, it would have precluded the necessity of so much correspondence. Such misreading of words often causes a great deal of trouble, and with regard to the double pulse valve I beg to differ greatly from "Glatton," as to the time of its use and situation. **P. J. Davies.**

[21979.]—The error into which Mr. Davies has fallen is, I think, in not considering that although there is a greater mass of water in a long trunk than in a short one, with same head, still in the long trunk ram more water will run to waste at the foot-valve between two successive beats, in order to produce the velocity necessary to close the valve. It is exactly the same as with a body on an inclined plane; the body must run a greater distance down a flat incline than down a steep one, in order to produce the same velocity. It is utterly impossible by merely increasing the horizontal length of the trunk to obtain more water from a ram; in fact, it is more likely that less water would be sent up in consequence of extra friction, and therefore the ram would be less efficient and more costly.

J. W. C. A.

ELECTRICAL LAUNCHES.

[21980.]—I quite agree with your correspondent Mr. Conry, that if electrical launches are to be brought into immediate use, the electrical energy must be obtained from primary batteries. Although the accumulator possesses every advantage in space, weight, and rate of discharge, over a primary cell, it is of no practical use until charging stations are erected, which from the present aspect of the "financial-electrical" horizon, is very far distant indeed.

The best and most efficient cell for such a purpose is undoubtedly a Bunsen; but the objectionable fumes of nitric acid, and the destructive nature of that fluid when in contact with the hull of the boat, or the clothes of the passengers, are serious disadvantages.

The bichromate cell, as used by M. Trouvé in his experiments has a single fluid, and therefore is more compact in form, but a comparison of the efficiency of such a cell with that of a corresponding Bunsen results in a verdict in favour of the latter, despite all its faults.

We still lack a *good* primary battery for motive power and domestic lighting. No doubt one will be discovered in the future that will, for simplicity, efficiency, and cheapness, eclipse all that are within the range of our present knowledge. Still there is no reason why, pending the invention of this cell, we should allow the application of electrical power to small vessels to lie dormant, since the disadvantages of the primary batteries we have at our disposal are not so great as to render them impracticable for the purpose.

The fumes of the Bunsen cell may, with judicious manipulations, be so greatly reduced as to be hardly discerned, and the danger of spilling the acids minimised so as to render boat and clothes safe from corrosion. In fact the whole cell may be modified; the nitric acid used may be less than half the quantity that is usually consumed, while the efficiency of the battery is unimpaired.

Mr. Toynbee has partially proved, by his experiments, that the consumption of zinc is not large, though I do not agree with his system of *diluting* the nitric acid, this process being unfortunately entirely automatic, and the result obtained rather too soon.

Mr. Conry asserts that he has not yet met with a motor that is fairly efficient. It is probable that he has not; still there are excellent motors in existence, giving from 80 to 88 per cent. of the electrical energy of the battery to the shaft. The only method of indicating the actual power of an electromotor is by dynamometer upon the shaft, and the result divided by the battery power gives the efficiency of the motor. Hence an electromotor compares favourably with the steam-engine, for the latter cannot utilise so much of the energy given out by the burning fuel as the electromotor does of the consumed zinc, and by measuring the actual power of a steam-engine in the same manner as an electromotor, and comparing the result with the indicated H.P., it will at once be seen that the loss between piston and crank shaft is considerable. When comparing the weight and efficiency of electromotors and steam-engines, this method of measurement ought to be employed to obtain accurate results. In fitting a launch with an electromotor, if the proper proportions of the vessel, propeller and motor be calculated, and with reference to the speed at which the motor performs most work while absorbing least current, there is but little difficulty in arranging a battery to produce the electrical energy necessary for performing the work required, with but a small percentage of waste; but this will never be attained by a slow rate of speed.

It is at present impossible to go from Sheerness to Oxford and back in an electrical launch, driven by accumulators, because there are no facilities for re-charging; but directly a few small pleasure boats electrically propelled by means of primary batteries are running upon the river, there will be hardly a boathouse without a supply of necessary chemicals, and until then, the enterprising experimenter in electrical navigation need not curtail his voyages, but rest secure in the knowledge that there are few English towns that do not possess a chemist's shop, and few chemists who do not include in their stock a few Winchesters of sulphuric and nitric acids.

Such a method of propelling launches is quite practicable, and will be successful when those who are experimenting in this direction are aware that a high speed and a propeller to suit that speed are necessary to obtain the most economical results.

Frederick Walker.

3, St. Loys-road, Bruce-grove, N.
Oct. 20th, 1883.

ELECTRIC ELEMENTS.

[21981.]—"Voltametre" wishes me to give some authority for the statements made in my former reply to him. As he quotes Mr. Gordon's work on electricity, those whose researches are given in it will perhaps be sufficient. In Ohm's Laws he will find the passing of electricity is assumed to be similar to the passing of heat through a conducting body—that is to say, as a single and not a dual agent, as "Voltametre" supposes in his first letter.

In the Vol. I. p. 26 which he refers me to he will find that the potential of the earth is taken as zero. Now, positive and negative are convertible terms, and have been used conventionally to the present time as regards electricity; but when a current passes between a body of positive and a body of negative potential, one or the other must be above or below the zero of the earth, according to the definition of "current" from Mr. Gordon's book given in "Voltametre's" last letter. The potential above that of the earth is supposed to be negative electricity, as commonly understood. The proof of this supposition will require further research. If you turn to p. 203 of the volume before mentioned you will find the production of the voltaic current described. Mr. Gordon, however, does not explain the appearance of hydrogen on the copper plate of the battery. On the true positive and negative theory, it is only a result of the chemical action of the current in its progress from the zinc through the connecting wire and copper plate, and so through the liquid to the zinc. An equal current from any source of electricity would give the same effect if it passed in the same direction.

The account of phenomena which seems most conclusive commences in Vol. II. p. 112 of Mr. Gordon's work, where Mr. Crookes' experiments on radiant matter are described. In these experiments the negative terminal gives the active force; the other one has no effect apparently. We can, therefore, assume that the negative potential is above that of the earth, and ought to be marked with the sign + instead of −, as is customary.

"Voltametre" will find that what he has objected to as being loose phraseology is a term of vital importance in the science of electricity, for when the true direction of the current has been established it will be a great step in advance.

J. Sutcliffe.

SCREWS.

[21982.]—I thank "J. K. P." I never did use a tap as a reamer but once, and shall not again, however much the long, taper, full-threaded tempters invite me. What advantages have these taps? I see few.

I was using Martin's table, and thought the holes given small, especially as some squeezing-up usually takes place, which would oblige the taps to ream out some stuff; and so looking into the table I found the sizes very near the theoretical, too near, as I thought, though taken to the nearest 64th only; and in one case a size even less than the theoretical was given—namely, the $\frac{7}{16}$, which "J. K. P." gives as $\frac{23}{64}$, and not $\frac{11}{32}$, as Martin does; and there is a similar instance in "J. K. P.'s" table: $\frac{29}{64}$, though nearer correct than $\frac{30}{64}$, is also under theoretical size. Martin gives $\frac{30}{64}$.

Now I apologise to "J. K. P." for mentioning this, seeing his table was not to be microscopically examined: but I do it to lead to my next question. Is it desirable to use holes so near the theoretical size, even for soft metals; or does "J. K. P." recommend them because common drills usually drill large.

Having broken a tap or two over cast iron, I drew up a table for myself, "omitting the rounded portion," as directed. I was anxious to verify it; the column taken from "J. K. P.'s" drills is so close to the calculated one, that I feel he must have weighed his words well; it is an additional proof that we may rely implicitly on his advice, if we wanted one.

The trick of grinding a drill point out of centre (so as to drill large) was told me by a friend of mine—a good working mechanic; the use of such to undercut (if I understand rightly) a hole for tapping solid steel is new to me. I have not yet tried it, but it looks very 'cute.

In what respect is the American thread better, or worse, than Whitworth? It seems a pity to have both. I can see that a rounded thread of 55° is perhaps harder to originate and verify than 60° truncated, though better for dies and chasers; but is there anything else one way or the other?

Are tools of 90° angle commonly kept in stock? Or is the use or necessity for them and angles finer than 55° so restricted that standards are undesirable? I can fancy that, even for dividing purposes, the angle should vary with the material, to get the best results.

As to the new model mandrel, I am sure the fitting of chucks would be harder than before. Next, while the cylindrical portion strengthens the base by doing away with the groove, yet if it is to have any decent effect in keeping the axis of chuck in a line with that of the mandrel, it should be at the top, not base, and then, perhaps, with a conical shoulder chucks might be made interchangeable. The thread would have to be a loose fit, I fancy, in most men's work; the fitting would be difficult, and it does seem a pity to lose the steadiness the extended surface of a screw gives, all (as it were) a double spiral conical shoulder, the chuck wedging itself firm between the two.

"G. C. C." has drawn a Holtzapffel nose with no groove; of course this is not fair if they all have them. With a broad shoulder they need not, but the groove practically increases the breadth of the shoulder, and that is a consideration in the case of back centre, light running mandrels, whose bearings need to be kept small.

I note another correspondent has mentioned that the cylinder is in the wrong place, but as my letter was written a fortnight back I leave it. I don't value the idea greatly though.

I meant to have asked "O. V." why he considers the slide rest hanging on the front of the lathe to be so well designed to resist the strain of the cut. It seems to me to be far less stiff than the old. What does "J. K. P" say? I suppose either form, though, is made stiff enough. **Bow.**

REPLIES TO QUERIES.

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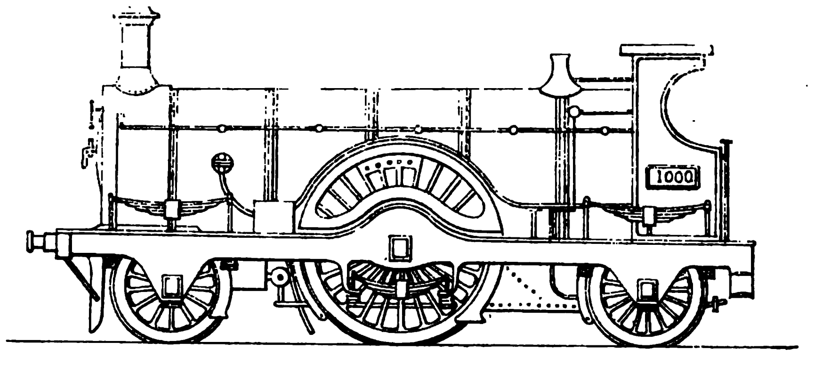
**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51056.]—**Medical Mesmerism.**—To "Sigma."—As I do not know the causes of the conditions described, I cannot say whether mesmerism would benefit; but it would do no harm, which is more than can be said of most things. The most certain way of benefit would be to obtain the full mesmeric sleep or trance, and let the patient remain in it for considerable periods, diverting his own nervous energy upon the parts, which can be done by telling him to do so. The recuperative power of nature is wonderful under those circumstances. As to direct action by passes, the querist is right in his intention; but the leg ought to be uncovered, and besides the local passes, I should begin and end with others the full length of the body.—Sigma.

[51203.]—**Music.**—"Teacher of Harmony" has pointed out what is doubtless the real difference between the action of the mutation stops of an organ and the forbidden consecutive octaves and fifths in an ordinary work. It is true that in the organ tone the intervals are very much reduced in power, and are put there for a special purpose. Still *they are there*; and so the absolute prohibition given in the textbooks needs modifying. I am much obliged to "Teacher of Art" for the trouble he has taken in dealing with the question. Any consecutive notes will yield the consecutive octaves and fifths on an organ "full to fifteenth"; and as "G. F. H." will scarcely deny that consecutive notes are used by all musicians, I need not quote passages. "Emeritus" takes it for granted that I never heard of Helmholtz or his work, and is good enough to give me a little elementary instruction in the theory of clang-tint, for which I feel very grateful.—Wm. John Grey, Elswick Science School.

[51223.]—**G.W.R. Engines.**—I send a sketch of the 1,000 class of G.W.R. singles as promised. The dimensions are as follows:—Boiler—length, 10ft. 6in.; diameter, 4ft. 1⅛in.; plates, $\frac{7}{16}$in. thick. Outside firebox (Lowmoor iron)—length (outs.), 6ft. 4in.; breadth (outs.), 4ft. Inside firebox (copper) length (outs.), 5ft. 9¼in.; breadth (outs.), 3ft. 6½in. Top of box to grate—5ft. 9½in.; bottom ditto, 3in. Smokebox—length outside, 2ft. 7¾in.; breadth ditto, 5ft. Chimney (taper)—diameter, 1ft. 4in. to 1ft. 6in.; height of top from rail, 12ft. 10½in. Tubes (iron)—250, diameter, 1⅝in.; length, 10ft. 11½in. Pitch of centres, 2¼in. vertical, 2in. horizontal. Heating surface, 1278·5 square feet. Cylinders, 18 by 24; centres apart, 2ft. 6½in. Driving-wheels, diameter, 7ft. Leading and trailing wheels, 4ft.; wheel base, 8ft. 6in. + 9ft. Frame—extreme length, 25ft.; extreme breadth, 6ft. 9in. Distance of centres of frame (inside), 4ft. 0½in.; ditto (outside), 6ft. 6in. Weight of engine (full), 32tons 10cwt.; ditto (empty), 28tons 10cwt. On page 416, No. 954, I gave a complete list of the G.W. singles (narrow gauge). I wish to add a few words in addition. Nos. 7 and 8 (Wolverhampton, 1859), have 6ft. 3in. wheels and cylinders 16in. diameter; No. 30 (1860), 6ft. 6in., 15in. cylinders; No. 110 (1862), 6ft., 16in. cylinders; 209—214 have 6ft. 6in. wheels and 16in. cylinders; Nos. 7, 8, 30, and 110 are not rebuilt engines, as I there mentioned, but came out new at the time. A drawing of the 157—166 class appeared in Vol. XXXIV. page 94. This letter, together with that on page 416, Vol. XXXVII., contains all the information required on G.W. singles, and I hope it answers many past queries. The tenders of the broad-gauge engines are shallow, because they hold quite enough water without additional height, owing to their great breadth. In this they have an advantage over the narrower tenders of the N.G.—Meteor.



[51228.]—**Deflection of Girder.**—The original question is rather unintelligible. The formula for the deflection of iron girders is as follows:—$\Delta = \frac{W \times L^3}{S \times D^2 \times 60}$ for wrought iron when Δ is the deflection in inches.

W = weight in tons in centre.
L = span in feet.
S = sum of the areas of the top and bottom flanges in sq. in.
D = depth in inches.
60 = constant when W is in centre of wrought-iron girder.
100 is the constant when W is weight in tons distributed on wrought iron.
40 is the constant when W is in centre of cast-iron girder.
66 is the constant when W is distributed on cast-iron girder.

—J. S. C.

[51242.]—**Secretary's Liability.**—This query, which is replied to by Mr. Wm. Jno. Grey, escaped my notice. If "Ireland" rented the room used by the society for their meetings, on their behalf and by their instructions, he would not be liable for the rent. Much, however, as Mr. Grey observes, depends on the form of receipt given for the rents which have been already paid. He should see in future that receipts should be made out something like the following:—"Received of the ....Society, per Mr................. the sum of £............for........quarters rent of the room used by the Society." The above is merely a precedent, which you can alter to suit your purpose.—G. Russell Pridham.

[51253.]—**New Zealand.**—I am of opinion that if you scratch "London Stone" you may find a Yankee land-jobber. Or, Dick Whittington like, he went to N.Z. expecting the streets to be paved with gold; though, unlike him, he failed to turn them to gold by the necessary labour. I have given considerable study to our colonies, and from a book now before me, written by a clergyman resident in N.Z. for many years, I quote the following: "The charm of N.Z. is its winter. The extremes of the English climate are unknown there. Fogs are unknown there. All English fruits flourish there: also figs, apricots, peaches, grapes, oranges, and lemons are grown, and ripen." The late Bishop Selwin wrote: "A sparkling breeze, a smooth sea, a cloudless sky, give that undescribable sensation of a really fine day which I have never felt elsewhere." After forty years, the Rev. J. Buller writes: "The climate is equable; it is both healthy and pleasant. Droughts are unknown, and floods are rare. There are occasional gales, but no hurricanes; the sky is generally bright, and the air pure." Dr. Thompson, who spent some years in N.Z., and who wrote a valuable work called "The Story of N.Z.," states that he found the death rate amongst British troops to be, per year per 1,000: Canada 20, Malta 18, Cape 15, England 14, N.Z. 8. Mr. Giffen's report to the Board of Trade gives the average yield of wheat to be 31 bushels, barley 35 bushels, oats 38 bushels, potatoes 5 tons per acre. Sir Julius Vogel confirms this, and states that the N.Z. farmer has an advantage over his brethren in Australia, the Cape, or in America, in the ratio of 10 to 1. So much for the Comonodore. In conclusion, don't let "Old Subscriber" or "Engineer" be frightened by the scarecrow stuck upon "London Stone"; but let them read "New Zealand," by Rev. J. Berry, James Clarke and Co., 14, Fleet-street, price 6d.; and the "New Zealand Handbook," to be obtained from the Agent-General for N.Z., 7, Westminster-chambers, Victoria-street, price 1s. 6d Wm. H. C., Ashton-on-Ribble.

[51484.]—**Three-Manual Reed Organ.**—I am glad to see that "Joiner" has come forward to help "G Minor" with his three-manual reed organ: and as the latter gentleman has expressed a wish for a brief specification, I now furnish one, which I hope will be found useful to him, and to anyone else who may like to build one of a similar class. Upper Manual.—Diapason 8ft., bassoon 8ft., piccolo 4ft., principal 4ft., voix celeste 8ft., saxaphone 8ft., wald flute 2ft. Centre Manual.—Diapason 8ft., principal 4ft., dulciana 8ft., flute 4ft., hautboy 8ft., contra bass 16ft., violoncello 16ft. Lower Manual.—Clarionet 16ft., cornet 8ft., musette 16ft., ophicleide 16ft., concert flute 8ft., flute harmonic 4ft., principal 4ft., sub-bass 16ft. Pedal organ, 4 sets of 30 notes each, as follows:—Sub-bourdon 32ft., bourdon 16ft., bass trombone 16ft., diapason 8ft. I would suggest two manual couplers, one of which will couple upper manual to centre manual, and the other to couple centre manual to lower manual. A pedal coupler may be added so as to connect manuals to pedals. Twenty full sets of reeds will not be required in this specification, which will evidently prove to be of sufficient variety for any reed organ, and as all these varieties of tone can be obtained by the skilful voicing of the several sets of reeds, it would not be advisable to introduce any further number of stops for the sake of mere imagination, or repetition of the same thing over again. I wish "G Minor" every success in his undertaking, and I hope, when he has completed it, that he will favour us by making known the results. I have left the choice of mechanical stops entirely to his own judgment except the couplers. A vox humana could be placed in connection with the reeds of the upper manual, if desired.—G. Fryer.

[51587.]—**Preparing Millboards, &c.**—"An Amateur" having asked for directions how to prepare millboards (in "E. M." of Sept. 7th, page 23), I venture to send him the following method, extracted from a work which I have had since the year 1839 (date of publication), but now probably out of print. The extract is a portion of the fifth chapter of a work on "Oil Painting," and translated from the original French treatise of M. I. F. L. Mérimée, at that time secretary to the Royal Academy of Fine Arts in Paris. As this account of the process of preparation differs in some respects from those answered in the following number of "E. M.," it may probably interest our querist. The chapter is headed, "On the Preparation and Grounds of Panels, Canvases, and Walls." After a few preliminary observations concerning panels, the advantages of canvas, as uniting cheapness and easy removal, whereas panels were often fixed to a particular place, the writer proceeds as follows:—"It is natural to suppose that panels composed of several pieces glued together might become disunited by the changes arising from dryness or moisture, to which pictures are always more or less subject. To prevent these accidents, very great care was taken in the earlier times, but latterly these precautions were neglected; bands of linen were glued upon the joining, and even occasionally they covered the entire surface of the panel with black tanned leather. The gluing on of linen bands is attributed by Vasari to Margheritone, who lived in the twelfth century; but it was known before his time, for the practice is described in Theophilus' treatise, De Arte Pingendi; it was probably brought into Italy by the Greeks." The writer then goes on to inform us from Theophilus that the planks or boards of which the panels were composed, were prepared, and "cemented at their edges by a glue made from cheese"; he then proceeds to explain at some length how this glue is prepared, after which we read as follows:—"The panels were anciently primed with chalk, dissolved in animal size; it is the same preparation which is still used by the wood gilders in preparing their frames and other work. Plaster ground is preferable to chalk, and the term *ingessare*, "to cover with plaster," is used by the Italian authors to describe the application of distemper grounds to panels. I have had occasion to analyse a portion of the ground of a picture by Titian, painted on wood; this ground was composed of plaster of Paris, with starch, and paste, but no glue or size, flour paste being used instead of gelatine. There has also lately a curious fact been discovered, namely, that a couch of distemper, which covered the envelope of a mummy, was composed of plaster mixed with animal glue. In the commencement of the art the canvases were prepared like the panels, with distemper grounds; and it has already been stated, that generally the pictures of Paul Veronese were painted upon such primed cloths. The practice now is, to prime the cloth with oil colour, changing the mode according as the canvas is of a closer or more open texture. When the canvas is very open, and lets the colour through, it must be saturated with size made of glove parings, laid on with a large palette knife or trowel, the edge of which should be blunt, and a straight as a rule, that the couch of size may be laid as evenly as possible; when the priming is quite dry, it must be rubbed with pumice stone, to make it free from lumps; then with a knife, a couch of ceruse is applied; when dry, this is also pumiced; a second couch is then put on, and sometimes a third, to obtain a perfectly even surface. Formerly the priming was made with dark red mixed with umber, or with pure umber; and some sixty years it was supposed that the drying of this colour would be quickened by mixing it with litharge: but it has been discovered that pictures painted on these sort of preparations, in a few years have their surface covered with a multitude of little grains like sand, and thus proving that the litharge was badly prepared. At the present day, the artists are more careful in such essential matters, and the colourmen, for their own sakes, are excited to prepare their canvases with more attention, for any negligence in these essential matters would ruin their trade. Cloth for priming without sizing ought to be of a closer and more even texture; in this respect ticking is peculiarly advantageous; for though at present it is not to be had of a much greater width than two yards, yet, if the manufacturers found a demand for it, they, no doubt, would make it up to any reasonable dimensions. If the cloth is not sized, it will require three or four couches of colour to insure an even surface; and before a new couch is applied time must be allowed for the former to dry hard enough to be rubbed with pumice. This is the reason why cloth requires in preparation two or three months in summer, and five or six in the winter season." (*N.B. The advantage in priming the cloth first with size is, that it prevents the absorption of the oil through the canvas, besides affording a closer and harder surface upon which to work with dry pumice stone.*—G. H. L.) "The time required for priming may be shortened very much, by making the first and second couches with distemper; and as soon as they are quite dry and pumiced into an even surface, let the last couch be merely oil, which has become viscous by exposure to the air; this will penetrate the distemper and render it quite pliant. By the former method much time is required to dry the cloth. But by this mode, as soon as the oil is absorbed, they may be rolled up like waxed cloths with perfect safety. As the pliancy of these cloths depends upon the complete union of the oil with the distemper, the absorption would be greatly facilitated by using a very weak size, mixed with a little oil, and a good quantity of mucilage of linseed meal, or the latter mucilage alone will do if well boiled." Thus far, says our author, he has not touched upon the preparation of millboards; but the process is the same. The directions for preparing, as given in "E. M." of September 14, page 44, by "E. B." Dublin, and "Fisherman," are both good; but the "mistake of the latter lies in this, that he brings in "water" as an element to assist the operation. Dry powdered pumice rubbed with the pumice stone itself will do far more than the water will effect—to say nothing of the dirt and slobber it will occasion—but as water is the element of the fisherman, we will excuse our friend in this case with all due deference to his opinion, millboard *is* a good material. It need not of necessity be absorbent. I would only further add that, except knowing how millboards and canvases are prepared, no advantage would be gained either in time or expense by "Amateur" preparing his own "boards," as they can always be obtained ready to hand at any of the artists' repositories.—Geo. H. Lancaster.

[51619.]—**Specific Gravity.**—Mr. Allen has already given you an equation for estimating sugar solutions (p. 150). Solutions of silver nitrate are best estimated by means of the argentometer (an instrument used by photographers), which shows the number of grains dissolved in one fluid ounce. It is not expensive, the price being not more than 2s. 6d. I am sorry I cannot help you with respect to solutions of sodium carbonate.—N. C. R.

[51620.]—**Photographic (U.Q.)**—Although I do not know for certain, there are, I believe, expert photographers in Tasmania, as in most other places, and unless, therefore, "A Would-be Photographer" is also a "well-up" photographer, he would not stand much chance. No doubt apparatus and materials are much dearer than here, and hence it would be to his advantage to take out as large a supply as practicable.—W. Robinson, Jun.

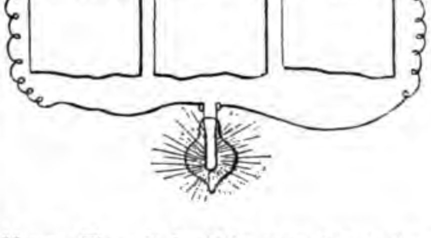
[51626.]—**Polishing Shells.**—These are cleaned by brushing them well in hot hydrochloric acid, rinsing in hot water, and drying in hot sawdust from any non-resinous wood. If the shells are without a naturally polished surface, it must be brought up by means of tripoli and a washleather. Some shells are ground through the outer case to show the pearly laminæ beneath.—Nun. Dor.

[51636.]—**Fish Oil.**—By filtering through animal charcoal you ought to be able to remove the dark colour; but as you want to deodorise as well, better try Dunn's process. Heat by steam to 180-200° Fahr., and then force air of same temperature through until sufficiently purified. There is also a process of stirring up with chloride of lime solution; but unless the new ozone bleach is cheap, you will find nothing so effective in bleaching as filtering through animal charcoal.—Nun. Dor.

[51637.]—**Stone Polishing.**—"Bobbydazzler" must rig up a lapidary's lap if he wants to do much in agate polishing; but if he wants to do a few only, a lapidary will slit them through for him at a small cost. Then to polish, let him wash up some emeries by the method so frequently described, and with a bit of smooth iron plate (glass will do), start a surface with emery, water, and elbow grease. Bring up to a dull polish with the finer emeries, and then finish on a bit of cloth with fine puttypowder. If querist wants to know how to rig up a "lap" or any further particulars, I am sure he will find plenty of information in the back volumes—at least I know I could.—Nun. Dor.

[51647.]—**Amber and Bone Bending.**—Amber can be bent by heating it gently; but some little experience is required, as it is apt to fly. Bone is bent by steaming or boiling, binding into the required shape until cold.—Nun. Dor.

[51659.]—**A Three-Cell Battery.**—(1) As to the solutions, take chloride of ammonium 1¼oz., muriatic acid 1oz., put in the porous cells, and fill up with water. Then make a saturated solution of bichromate of potash, mix 2 parts of the solution with 1 part of muriatic acid, and fill the outer cell within an inch from the top; the two liquids should be level with each other, as per drawing on p. 93 in No. 966. The cells should now be connected together alternately with stout copper wire or strips of copper 6in. long ½in. wide (i.e., carbon to zinc, &c.). (2) Electric bell wire would do; but I should prefer our reader to use the above, as better results are obtained. (3) The ends of the wires proceeding from the zinc and carbon respectively should be connected with the wires from the base of lamp. The ends should be scraped clean about an inch before joining, so as to have a proper metallic connection. (4) This battery will bring up a 2½ c.p. Swan's incandescent lamp to its full power, providing you ask for one of "low resistance" when purchasing. A very beautiful and attractive effect can be produced if the lamp be placed in front of a multiplying reflector. When the battery is not in action, the zincs should be removed from the porous cells and placed in a vessel of water till required for action. I forgot to mention that a little mercury (¼oz. to 1oz.) should be placed at the bottom of the cells in which the zincs are placed.—Electrician.



[51665.]—**Setting Valves.**—Fully explained on pp. 582, 601, last volume, and several times in back numbers.—Essar.

[51667.]—**Fixing and Erecting Machines.**—Answered so recently as pp. 417, 558, last volume. See also indices of back volumes.—Essar.

[51676.]—χ **Cygni.**—The querist should look up the star himself. It is absurd to ask a resident in London for observational information of this star.—C. T.

[51681.]—**Magnetism.**—The answer to this query is yes; but it can be easily settled by a trial. —J. M.

[51688.]—**Hydraulic Lift.**—I don't know where the largest hydraulic lift is situated; but should suppose that on the Weaver Canal is big enough for correspondent.—E. T.

[51693.]—**Chandelier.**—Send it to the lacquerer's. It wants dipping and relacquering. Directions in back numbers; but much cheaper to have it done by those who have the appliances ready to hand.—Essar.

[51730.]—**M. R. Engines.**—No. 140 is a four-coupled bogie tank, single frames, built at Derby in 1875, used for metropolitan traffic, coupled wheels, 5ft. 6in., cylinders 17in. by 24in. No. 195, four-coupled double-framed passenger engine, Beyer, Peacock, and Co., 1867: cylinders 16½in. by 22in., wheels 6ft. 2in.; 195 was rebuilt 1880. 603 is six-coupled goods, Kitson, 1867; wheels 5ft. 2in., cylinders 16½in. by 24in. 1123 is six-coupled, side tank, Neilson, 1875; wheels 4ft. 6in., cylinders 18in. by 24in.; 1632—1636 (1883), bogie tanks, 5ft. 3in. wheels, cylinders 17in. by 24in. In this class the eccentrics are cast on to the crank shaft. 200, 221A, and 1093, six-coupled, double-framed, well tanks. Many of this class were built at Derby 1860—4. I cannot give dimensions. 200 was rebuilt in 1875. 2061, small four-wheeled outside cylinder, saddle tank, by Manning, Wardle, and Co. 880—889 are six-coupled side tanks for Metropolitan goods traffic, by Beyer, Peacock, and Co., 1871. They are very powerful engines, but I am sorry I cannot give dimensions.—Meteor.

[51772.]—**Brighton Engines.**—I send the following dimensions of the new express passenger engine, "Gladstone," now running on the London, Brighton, and South Coast Railway:—

	ft.	in.
Diameter of cylinders	1	6¼
Stroke ,, ...	2	2
Length of boiler (barrel)	10	2
Diameter ,, (outside)	4	6
Length of firebox (external)	6	8¼
Breadth outside, bottom	4	1
Length inside, bottom	5	11¾
Breadth ,, ,, ...	3	4¾
No. of tubes	331	
Length ,, over all	10	8¼
Diameter of tubes outside	0	1½
Heating surface of tubes ..	1372·92 sq. ft.	
,, ,, firebox..	112·48	
Total heating surface..	1485·40	
Grate area..................	20·65 sq. ft.	
	ft.	in.
Diameter of leading and driving wheels	6	6
Diameter of trailers	4	6
,, tender wheels	4	6

The weight is distributed as follows:—

	Tons	cwt.
On leading drivers..............	13	16
,, trailing ,, ...	14	10
,, trailing wheels..............	10	8
Total weight of engine........	38	14

The weight of tender in working order is 27 tons 7cwt., and is distributed equally on each pair of wheels or 9 tons 2cwt. 1½qr. each. Total weight of engine and tender in working order is 66 tons 1cwt.

	ft.	in.
The total wheelbase of engine and tender is	38	9½
From centre of leader to centre of driver........................	7	7
From centre of driver to centre of trailer	8	0
Total wheel base of engine..	15	7
Tender—		
From centre of leading to centre of centre wheel	7	0
From centre of centre wheel to centre of trailing	7	0
Total tender wheel base	14	0
Capacity of bunker	2 tons	
,, ,, ...	2,250 gals.	

The "Gladstone" is painted the usual colour of L.B. & S.C. Co.'s engines—viz., yellow, picked out with black and red lines. It is fitted with the Westinghouse automatic brake on the wheels of the engine, and also, I believe, on the tender. It was designed by Mr. Stroudley, and built at the company's works at Brighton. I may mention that the cylinders are cast in one piece, and the slide valves and ports are underneath.—H. N.

[51792.]—**Cancer of the Mouth.**—"Observer" writes that he knows a lady who knew a young man who was cured of a cancer in his nose by bathing at a Welsh spring. This must obviously be wrong, for—1, cancer (Carcinoma) never affects the nose in any form except that of epithelioma, which is commonly a disease of advanced life; 2, cancer is in its nature incurable, except by removal either by the knife, cautery, or caustic. "Nun. Dor." attempts to raise a laugh against Dr. Allinson by quibbling with his words, and in reality shows his own ignorance of the meaning of the preposition "of," which, if he will consult any good dictionary, he will find, amongst other things, may mean "produced by"; and it is obviously in this sense that Dr. Allinson uses it. Then, again, he denies what Dr. Allinson asserts, and what is an undoubted fact—that local irritation is the determining cause of epithelioma; and I may say that it must be so from the following fact alone: I have seen about 300 cases of cancer of the lower lip—all men, never a woman amongst them. There are about five cases of cancer of the lower lip in women recorded, and all of them have been smokers. I should take up too much of your valuable space if I took the trouble to contradict all "Nun. Dor's" statements; but their value may be estimated from the above.—St. Bart's.

[51792.]—**Cancer of the Mouth.**—Thanks to "Nun. Dor." for his criticism. I will reply at greater length. Cancer is produced by two causes: a predisposing and an exciting one. The *predisposing* ones are eating too much animal food, and not getting enough fresh air and exercise. The *exciting* ones are irritation of some kind, as of pipes or braces, or even a blow or injury may give rise to it. But in cancer of the lip the exciting cause is the pipe, and the chances are it would not have appeared there but for the pipe. But because cancer appears on the lip from the friction of the pipe, I hope "Nun. Dor." does not infer that it would have appeared elsewhere if it had not appeared there. On the contrary, some other disease might have set in and cleared the system of the material predisposing to cancer. It is clear to anyone who will take the trouble to inquire, that an epidemic of small-pox lessens for a time the deaths from cancer; in other words, small-pox attacks those whose systems are in such a state as to favour the development of cancer, and either kills them off or else clears the system of waste matter, and so cancer cannot arise. "Nun. Dor." must not quarrel with words, and speak of "an irritated pipe"; but I will remind him of one of his slips. He speaks of tobacco as a harmless *vice*. Now a vice is never harmless, and I am glad that he acknowledges the tobacco habit to be a vice. "Nun. Dor." again quarrels with words about "the prevalence of cancer." If he will look at the heading of my reply, he will find it "Cancer of the Mouth," and my answer about it being "uncommon in women and non-smokers" meant that it is uncommon in these people in that particular situation. As to the connection of cancer in other parts of the system and the tobacco habit, I cannot give any information, as I know nothing about it. As to the cure of cancer, I have heard, just lately, of a case, where a diet from which all animal food has been excluded, together with bathing, has almost effected a cure. If it effects a cure, more will be heard of it. "Nun. Dor.'s" Parthian arrow I will not return; but I see an opening in his armour where I could thrust it and give pain. I fight not with men, but with their opinions and beliefs.—T. R. Allinson, L.R.C.P., &c.

[51796.]—**Photographic.**—Yes; gelatine plates answer admirably for this sort of work, though they need not be "slow" ones. The main points are to avoid over-exposure, which would tend to "flatness," and to keep the developer well restrained, so as to get sufficient density. The exposure is sure to be a good deal longer than for landscape work; but when once you ascertain the correct time, you should be able to do a lot without any material variation.—W. Robinson, Jun.

[51822.]—**Pyro.**—I remember purchasing a bottle of pyro., answering this description, some eighteen or twenty years ago, though I believe it was of English manufacture. It was O.K., and kept good for many years, pyro. not being so much used in those days.—W. Robinson, Jun.

[51826.]—**Brakes on the L. and N.W.**—In my reply, page 135, I mentioned that the north portion of the 7.15 a.m. from Euston was fitted with the chain brake, but that it was about to be removed from the West Coast Joint Stock. This change is now being carried out, and the north portion of the 7.15 a.m. train will now be formed of carriages fitted with both Westinghouse and vacuum brakes; the next train ordered to be fitted is the 10 a.m. from Euston, the vehicles being nearly completed. It is stated at Crewe that in a year the chain brake will be a thing of the past on the main lines.—Clement E. Stretton.

[51845.]—**Photo. Studio.**—If you will refer to my reply to No. 50635, p. 391, of last volume, you will find some hints that may be useful, though in matters of this kind it is not easy to give sound advice without being personally acquainted not only with the dimensions, but also with the surroundings, of any proposed studio. Generally speaking, a north light falling in front, and somewhat to one side of the sitter, is best; but if unattainable, a good deal may be done in the way of modifying an unfavourable light by the judicious employment of reflectors.—W. Robinson, Jun.

[51848.]—**Lost Watch Wheel.**—As there are a few errors in this reply I hasten to correct them. Line 12, read "gives two vibs." Line 9 from bottom of same column, read "than there are leaves." Page 158, lines 12 and 13, leave out "by"; read "when the product of the fourth wheel, 80, 64, and 30, is divided by the product of the." Line 16 from bottom, fourth term, read "·1117." Lines 7 and 6 from bottom, read "the rule is, as the diameter of the wheel is to its No. of teeth + 2·25, so is the P.L. to half sum of wheel and pinion." All is now right to end of reply. In continuation of this subject, allow me to say that the pinion's diameter can be found as stated in 16th line from end of reply, p. 158, as well as from the third wheel (in the case of a lost fourth pinion). In this latter case we have the number of third wheel and its diameter, and having found that the fourth pinion must be an eight, state the proportion thus:

Wheel. Diameter. Pin. Diameter.
62·25 : ·73235 : : 9·5 : x = ·1117.

The addenda 2·25 is given to the driver, and 1·5 to the driven, be it wheel or pinion. In replacing a wheel and pinion, as in this case, to make it successful, it is well to examine the shape of the third wheel teeth, and leaves of the escape pinion, for if the wheel has more tooth than space, the fourth pinion should have thin leaves, and bay-leaf shaped, as also the teeth of the fourth wheel. Care should be taken there is no drop or rubbing in of the teeth. As regards the wheels and pinions for showing the hours and minutes (commonly called "the motion," or dial wheels), the two pinion's numbers may be assumed, and their product + 12 (the ratio of the minute-hand's revolutions to the hour hand) gives a product to be divided by prime numbers, as was done in Ex. *a a'*, *b*, *c*, and rightly arranged the numbers for the minute and hour wheels, thus: Let the assumed numbers be 12 and 10, then 12 × 10 = 120 × 12 (the ratio) = 1440, and being divided by

$$36\left\{\begin{array}{l}\left\{\begin{array}{ll}2 & 1440\\ 2 & 723\end{array}\right.\\ 40\left\{\begin{array}{ll}2 & 360\\ 2 & 180\\ 2 & 90\\ 5 & 45\end{array}\right.\\ \left\{\begin{array}{ll}3 & 9\\ 3 & 3\end{array}\right.\end{array}\right.$$

we have cannon pinion = 12, mt. nut = 10, hour wheel = 36, mt. do. 40. This can be done another way, thus: Write down 3 × 4 over these figures, whatever numbers you like for the pinions. $\frac{14}{3} \times \frac{16}{4}$ × the upper by the lower, gives 42 and 64 for hour and mt. wheels, = 12 hour motion. If for a 24 hour— $\frac{14}{6} \times \frac{16}{4}$ pinions. = 24 hour
84 64 wheels.

—R. E. B.

[51863.]—**Arranging Brass-Band Music.**—If I rightly understand this query, "Euphonium" desires to know how to arrange some music to play on a band of 24 instruments which he already has, and does not require information—as G. Fryer seems to suppose—as to what instruments to form the band with. To give sufficient instruction here would occupy far too much space, but if "Euph." will send me something he would like to play, I will arrange it for him. He will get more information from a thorough study of the score than from half a dozen pages of written matter. If I misunderstand query, and "Euph." does want to know what instruments to form band with, I beg to submit following:—7 cornets as follows: 1 soprano, E flat; 1 solo, B flat; 2 firsts, B flat; 1 repieno, B flat; 2 seconds, B flat; 5 tenors, E flat (1 as solo), 2 tenor trombones, B flat; 2 baritones, B flat; 1 solo euphonium, B flat; 1 bass euphonium, B flat; 1 bass trombone in G; 2 bombardons, E flat; 1 bombardon B B flat; side and bass drums.—J. Johnson, Huyton, Liverpool.

[51864.]—**Indicator Diagrams.**—To A. A. Myall.—I am sorry to say the diagrams I sent were reduced by the engraver to about one half the size. They are now a little large of $\frac{1}{48}$th scale. The greatest pressure of steam we get is 27lb., and about $9\frac{1}{2}$ to 10lb. vacuum, with particulars as stated in my query. Shall be pleased to hear from "A. A. M."—P. A. D. [People sending diagrams should have some little consideration for our space! —Ed.]

[51895.]—**Old Files.**—None of your readers seem to give a good answer to the question of making chisels out of old files. There is no need to soften them, as to do so means hardening again and tempering afterwards, and as old files, or files generally, are hard, all that is needed is to temper them a little lower; in fact, they will make good chisels or turning tools as they are; but being harder than required, they chip. All that is wanted is to let them down, as we call it, which is done by making bright, by rubbing on a grindstone or flagstone until there is sufficient bright surface to watch the heat given them to produce a straw or deep straw colour, then stop and let cool. The best way to effect this is to put a piece of bar-iron into a fire and make redhot, then place the file with the bright surface upward, and watch for the straw colour coming up; then let cool, taking care that the file does not remain on the hot iron until it takes a silver colour, for then it would soon lose its edge for cutting. I have cut old plyers out of a chisel made in this manner.—A Reader of "E.M."

[51899.]—**Medical Coil.**—"Thor" says I have made a mistake; but may I tell "Thor" that before I answered his query I placed a small coil that I have, inside a tin tube, and also wound some thick copper wire round it, and in both cases it worked all right. Will "Sigma" please say why it should not work? I thought induction would go on in the coil as well as in the tube, which I found was the case when I tried my coil with the copper wire round it.—Watt.

[51899.] — **Medical Coil.** — Considering the further remarks (p. 158), I may inquire why on earth (or tropical Africa) such a complication as a coil and a thermopile should be used at all? Why not be content with a portable magneto-electric machine, which will do the same work? If a little magic is wanted, a coil could be made up in one hand and the cell in the other by making the handle out of a split cylinder instead of a tube, and connecting the two handles by a pair of wires carrying the current from battery to coil. The battery might be a good chloride of silver one, such as is made up in ebonite tubes. A fine wire would be wanted to connect one terminal of three to the further handle, and all secondary wires could be made into one.—Sigma.

[51908.]—**Shakespeare on the Stars.**—I trust "F.R.A.S." will excuse my supplementing his reply about "the unfolding star" in "Measure for Measure," Act iv. Sc. 2. In my edition of Shakespeare (Stevens, 1803), the following quotations are given in illustration:—

> "The star, that bids the shepherd fold,
> Now the top of heaven doth hold."
>
> —Milton's "Comus."
>
> "So doth the evening star present itself,
> Unto the careful shepherd's gladsome eyes,
> By which unto the fold he leads his flock."
>
> —Marston's "Insatiate Countess," 1613.

—Charlie.

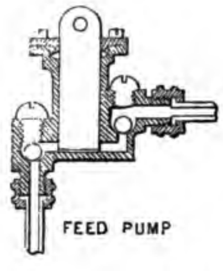
[51908.]—**Shakespeare and the Stars.**—The replies given to this query do not appear to me to be correct, and are not in accordance with the usual explanations. The "watery star" of the "Winter's Tale" is simply the moon, of which Shakespeare speaks in the "Midsummer Night's Dream" as "the moon, the governess of the floods." "The stars, I see, will kiss the valley first," is but a poetical expression for never; and "the unfolding star which calls up the shepherd," in "Measure for Measure," is the morning star, which warns the shepherd to unfold his sheep. Astrology is referred to a hundred times by Shakespeare, but none of these passages have anything to do with it.—Achespe.

[51912.]—**To Violinists who are Mathematicians.**—The problem presented is one that admits of solution. It will be necessary to have accurate knowledge of the mathematics of music, so far as in this case they apply, before a mathematical demonstration of the kind postulated can be formulated. The violin being tuned in fifths, and the ratio sustained by fifths in music being as 2 to 3, if the violin is in perfect tune and the G string being taken as 2, D will be to it as 3; and, again, D being taken as 2, A to it will be as 3, and similarly with respect to A and E. It has been ascertained that the lowest sound that can be appreciated is produced by vibrations at a ratio of 27 per second of time, while the highest is that of 37,000. The question here is, how many vibrations per second produce, for example, the Philharmonic A on the violin, how many E, D, and G? This requires first to be correctly ascertained. It has been said that students who have undergone a tonic-sol-fa course of musical instruction experience, comparatively with other pupils, little difficulty in learning to tune the violin when put to that instrument. Perhaps some mathematical tonic-sol-faist will kindly assist in throwing light on this question.—Student.

[51926.]—**M. R. Locos.—Goods Engines.**—Wellingborough, 720—739; 1150—1221 (with a few exceptions); London, 760—779; Bedford, 840—849, 454, &c.; Leicester, 621—659 and 240—259 (including Wigston); Nottingham, 224—229, 310—329, 450—479 (most); 1599—1601, &c.; Skipton, 383—385, 1371—1374; Carlisle, 1222—1243; Manchester, 1452—1471.—Meteor.

[51944.]—**Coppered Wire.**—S. Austel is in error in stating that copperas is employed for coating iron with a film of copper. He probably meant sulphate of copper (bluestone). The query was correctly answered by Mr. Bennett.—[illegible], F.C.S.

[51914.]—**Feed Pump.**—Here is a sketch of a pump which may suit your purpose. As you



FEED PUMP

intend fixing it on the boiler, you had better have the plunger large enough, say ¼in. diameter, so that the pump will be able to start of its own accord when hot, as it will be sure to get so when fixed as you say. If you do not have a good suction, the pump will not be able to draw the water without your dropping some cold water on to cool it. The valves are ball valves of selected lead shot, which I have found answer the purpose admirably.—S. Austel.

[51943.]—**Income-tax.**—I believe the Friendly Societies are exempt from this tax. The amount deducted can be reclaimed from the local Inland Revenue Office, by obtaining from the bankers, each half-year, a certificate of the amount deducted. If preferred, this need only be done once in three years, as claimants are allowed a return going back to that time.—Shylock.

[51945.]—**Boiler.**—The boiler built with the greatest number of rings of plates is the strongest, from the fact that there is a greater amount of metal in the same length of boiler—that is, supposing the boilers are both plated alike; but if one is plated with the longitudinal seams in line, and the other in break joint, then the break joint plating will be strongest, irrespective of number of rings of plate.—Boswell.

[51945.]—**Boiler.**—My short answer to this query was, unfortunately, too late for last week's issue, so, now, having a little spare time, I will try to further explain the difference in point of strength of boilers constructed as shown by "C. T." In my former answer it will be seen that I consider the boiler of 11 rings stronger than the boiler of 8 rings; my reasons for which are as follows:—The formula for bursting pressure in a longitudinal direction is $P = (2\,T\,C) / D$ (P = pressure, T = thickness in inches, C = tensile strength of metal, and D = diameter in inches), and for pressure tending to burst cylinder in a transverse direction is $P = (4\,T\,C) / D$, from which it will be seen that a boiler shell is weakest in a longitudinal direction. Hence the custom of double riveting longitudinal seams, the seams being the weakest part of shell, and the longer the seam the weaker it is. Hence the custom of arranging plates to break joint, the old system of seams in line being now obsolete, on account of their weakness; therefore the greater number the rings of plates, the shorter the longitudinal seams, thus increasing their strength, and reducing their liability to leak. It is argued that the greater the number of seams the greater the liability to leakage and seams giving out. This is all very good as far as longitudinal seams are concerned, but quite a different thing with ring or transverse seams. Under ordinary fair working conditions, ring seams are never known to give way; it is only in exceptional cases, such as excessive straining from overheating, &c., which causes ring seams to give way. Any of our friends who have seen a boiler tested to destruction will readily bear me out, when I say boiler shells of ordinary construction always fail in a longitudinal direction, and leakage from ring seams is due to imperfect workmanship. Again, the overlap at each ring seam is an extra thickness of plate, equal to a belt, so that in eleven plates there would be ten of these overlaps or belts, while in the boiler of eight rings there would only be seven of these overlaps or belts. (Here is the idea of one of our correspondents a few weeks ago, who asked if separate belts could not be applied.) Thus, with ordinary lap seams, there would be equal to 7½in. more metal in the first boiler than in the second, which would make it about 2 per cent. stronger. I have known cylinders made of narrow plates, specially to gain strength, by seams overlapping each other, due care being taken as to placing of seams, and I know of a vessel being made, about 25ft. long, to carry a pressure of 1,500lb., which had to be made of weldless rings of about 1ft. wide; wider plates could not be made to stand, the wide plates being given to buckling and bulging. There are many points about every boiler which might be of more importance than those given by "C. T.," such as openings in shell, and how strengthened, and under what conditions are boilers working, and how are seams spaced—in line or breaking joint; what about end plates and furnace tubes? These should always be given in boiler queries.—Boswell.

[51952.]—**Stage Micrometer.**—Draw your micrometer in black lines on a white surface on a large scale; take a negative of it, making same as sharp in the lines and as dense as possible. Take a little asphaltum, powder it, and drop a little into about ½oz. of benzole, which will dissolve it freely; make it about as thick as collodion. Pick out the clearest 3 by 1 glass slip you have, clean well, and rub one side with French chalk. Coat chalked side with the asphaltum solution, put it on your turntable, and whirl it till the benzole evaporates and leaves a film of asphaltum on the slide. Lay it aside to set for 24 hours. Now take your negative, and putting the asphaltum-coated side of the 3 by 1 slide next to table, put your negative collodion film side also downwards upon this, bind together at the ends with a bit of gummed paper; make a brown paper tube, 4ft. or so long, and expose to the light in it, in such wise that the light passes through the negative to asphaltum film. The exposure will vary from one hour to ten, according to light; but a trial or two will put you right. When you judge it to be sufficiently exposed, place it in a developing dish, and cover over with about ½in. of spirits of turps; this will have a feeble action on the asphaltum film; pour it off, and add a little benzole, and pour over slide again, and it will dissolve film more energetically. You may assist the development with a camel-hair brush; continue till the lines appear sharply defined on the clear glass beneath. Let us know how you succeed.—G. W. W., Newcastle.

[51958.]—**Electro-Plating.**—The fault lies in the bath. You have too little free cyanide. There should be a certain proportion of cyanide of silver and a certain proportion of free cyanide. This free cyanide attacks the anode and dissolves it, supplying the solution when all goes well with just as much metal as is deposited on the goods. If care is not taken to keeep up the right quantity of free cyanide, the bath gets poorer in silver, and loses part of its conductivity. If the anode is very white in working, there is too much free cyanide, and if dark too little. When the proportion is right, the anode appears a cream colour or very pale grey during the passage of the electricity, and turns to white when the current is stopped. Add cyanide of potassium to your bath; but you will probably find, if you have worked it much in the bad condition it is now in, that you have robbed it of silver as well; therefore add a little silver. Always work with an anode surface as nearly as possible the same as the surface of the goods, and if your solution is in right order, just as much will be dissolved off the anode as is thrown on to the articles. If this causes too much electricity to pass, you must reduce your battery power rather than decrease the size of anode. The strength of silver in solution can be brought up to what it requires to be, by using too large an anode until the quantity required is worked in.—J. E. A.

[51972.]—**Valuation.**—Assuming that the property is occupied for the 19 years, it would bring in (if the rent were put out as received to compound interest at 5 per cent.) approximately £3,050, which should equal the sum paid for the property with compound interest at 5 per cent. Therefore, by application of the formula [$A = P\,(1 + r)^n$], you have—

$$3050 = P\,(1{\cdot}05)^{19}$$
$$\therefore 3050 = P\,(2{\cdot}533 \text{ nearly})$$
$$\therefore \text{Principal} = 3050 / 2{\cdot}533 = £1{,}204 \text{ or } £1{,}200 \text{ nearly.}$$

Deducting £100 to cover probable expenses and loss of rent, you have left £1,100, which you might safely pay for the property.—J. P. Stafford.

[51973.]—**Velocity of Steam.**—The velocity of steam into the atmosphere is given by the following formula:—

$$v = 12{\cdot}15\sqrt{P\,S}.$$

where

v = velocity in feet per second.
P = pounds per square inch of steam above atmosphere.
S = specific volume of steam at the given pressure (i.e., the cubic feet of steam evaporated from one cubic foot of water.)

Taking the value of S from Molesworth, and assuming atmospheric pressure = 15lb. per square inch, the velocities for pressures of 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150lb. per square inch above atmosphere are 1,212, 1,470, 1,592, 1,670, 1,730, 1,765, 1,800, 1,829, 1,864, 1,870, 1,905, and 1,938, as calculated roughly on slide rule.—Glatton.

[51974.]—**Engine.**—To "Glatton."—I do not quite understand this query. Is the port in valve made so long that the three cylinder ports are all connected when valve is at half-stroke? Zeuner's diagram may be used to solve such questions, and if the Editor will insert it, I should be pleased to describe its application to such a case as I have supposed yours to be—an application which I have not seen published. —Glatton.

[51977.]—**Ejector.**—I have generally found that when an ejector has to force the water above 2ft. or 3ft. vertically, it is better to put it into the water to be forced. But the one you mention may be ticklish from other causes. There ought to be plenty of water space round the steam cone, and the delivery should be larger than the steam supply. Thus, ½in. steam supply pipe and ½in. suction should have ¾in. delivery. I made an ejector a little while ago, out of some gas sockets. With 35lb. steam it would lift 3ft. vertically (suction), and force 12ft., and would work with the water at 80°.—Labor Omnia Vincit.

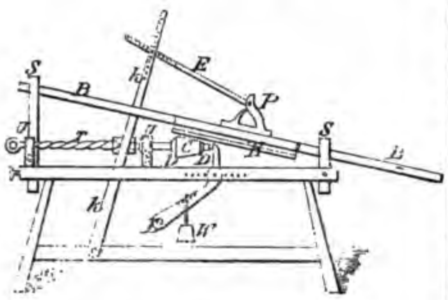
[51977.]—**Ejector.**—Does the water come out full bore in a solid stream when working, or is it white and broken? If the latter, as soon as the ejector has started, turn the steam off slightly until the water comes out in a more solid jet. If this does not answer, put a length of pipe, say, 18in. to 24in. long, between ejector and the boat's side. I have been told that this has cured this fault in cases similar to yours, but I cannot speak from experience, as all the ejectors I have seen worked well. If you think the proportion of the jet in fault, I will give an opinion if you send a sketch to scale of the concern; but I have no rule beyond that of experience.—Glatton.

[51978.]—**Hyposulphite of Soda.**—The following is taken from Lepold Gmelin:—One pound of pure crystallised carbonate of soda is dried as perfectly as possible, and intimately mixed with 5oz. of pure sulphur. The mixture gradually heated in a glass or porcelain basin to the melting point of sulphur, and kept at that temperature for some time, stirring constantly in order to bring every part in contact with the air. The sulphide of sodium formed at first absorbs oxygen from the air, and is converted with feeble incandesence into hyposulphite of soda. The mass, when cold, is dissolved in water, boiled with sulphur for some time, and filtered; the filtrate evaporated to crystallising point. Very fine and pure crystals are obtained in this manner. If heated too strongly, part of the sulphur is burned off, and carbonate of soda remains undecomposed. In this case a second crystallisation is necessary.—George Hart.

[51979.]—**G. W. R.**—There are three classes of B. G. singles, viz., the 2001 class (2001 to 2003) having 18 × 24 cylinders, 8ft. drivers, and single frames throughout; the Alma class having 18 × 24 cylinders, 8ft. drivers, and double frames for drivers, and single for leading and trailing wheels; and the 2007 class (2007 to 2014) having 17 × 24 cylinders, 7ft. 6in. drivers, and single frames throughout. The above three classes have cabs, no domes, and inside cylinders. 2001 to 2003 and 2007 to 2014 once belonged to the B. and E. R., by which company 2007 to 2014 were built about 1870. Before 2001 to 2003 became the property of the G. W. R., they were large single-wheel bogie tanks, having a bogie at each end. Nos. 149 to 156 (narrow gauge) are 4-coupled, inside cylinder, double framed tender engines; having cylinders 17 × 24, drivers 6ft. 6in. They were built by "G. England and Co., London," in 1862, have been rebuilt at Wolverhampton at different dates within the last few years, and have cabs, brass domes, and are mostly stationed at Wolverhampton.—J. E. Spencer, Birmingham.

[51983.]—**Honours: Solid Geometry.**—The querist should use "Payne's Elements" and Angel's large book for the co-ordinate geometry, working every problem, or satisfying himself that he can do so. He may use "Dennis's Third Grade Book for Perspective," which contains more than is needed. Up to last May, these would have been sufficient; but I see from the "Directory" for this year that a new class of subjects has been added to the syllabus for Honours—namely, Graphic Statics, involving—1, the representation of numbers, areas, and volumes by lines; 2, composition and resolution of forces acting in any direction in a plane; 3, graphic determination of centres of gravity in plane figures. 4. Determination of the resultant couple of a system of couples in one plane. 5. Construction of stress diagrams for simple roof trusses symmetrically loaded. These requirements involve some knowledge of mechanics, and being a new addition renders it difficult to advise. The querist might use Twisden's "Theoretical Mechanics," taking care to work the problems by construction. I deem it right to inform "A. P. G." that I have not attempted the Honours examination, and hold only a 1st class advanced certificate. I cannot give any advice as to machine drawing. A book has been published entitled, "The Whitworth Scholarships, and how to obtain Them," price threepence. —Wm. John Grey, Elswick Science School.

[51988.]—**Taper Cork-Cutting Machine.**—A cork-cutting machine is really a lathe with a very coarse screw-cutting arrangement. The sketch herewith will give you a good idea of what the machine is like. A knife K, about 2ft. 6in. long, is guided by a bar B on two adjustable standards S. The cork is made to revolve between two centre plates D. Motion is given to the lathe spindle (which is twisted like an American drill) by means of an adjustable lever F, and attached by a rod E to the plane-handle P. The pieces of cork to be shaped are placed between the centres by the operator, who opens the loose headstock (we will call it), which is also adjustable, by lifting the lever L with his knee. He then, after seeing it fairly centred, takes hold of the handle P, twists it over from him (the knife is attached to the handle, and the handle is attached to the bar by a hinge) a little to make the knife shave off the projecting portions of the cork, when he takes a first stroke; he then brings back the knife, lets it fall as low as it is adjusted to, and then takes the finishing cut, when up goes his knee against the lever L, and out falls the cork into a trough, which carries it away to a basket. The corks are then sorted and packed.—S. Austel.



[51989.]—**Burnisher.**—It is not at all probable that the brass roll is at fault, though as you speak of a "plate" of steel, possibly there may be some other defect in the construction. The burnisher proper consists simply of a bar of steel about half an inch in width, welded on to an iron base. Then, again, do you use a lubricator? If not, make an alcoholic solution of white (Castile) soap, of the strength of two or three grains to the ounce of spirit (methylated will do) and brush it over the prints before burnishing.—W. Robinson, Jun.

[51993.]—**Engine Query.**—An indicator diagram will show the amount of cushioning, also the steam admission, &c. Defective cushioning may be remedied by putting lap on the exhaust side. The thump complained of may arise from the brasses of the plummer blocks being fitted badly or out of adjustment. An engine running at 140 revolutions per minute, requires the valve to have plenty of lead, early exhaust, and well cushioned. With good workmanship, design, and strength, the engine will then work quietly.—Labor Omnia Vincit.

[51993.]—**Engine Query.**—I can hardly wonder at the thumping noise which C. Guillaume complains of with an engine making 140 revolutions per minute. There is no doubt that a certain amount of cushioning in a quickspeed engine is an advantage. But if your noise arises from defective cushioning, just by way of experiment, I should bring the valve forward, so as to make the exhaust close sooner, and note the effect, and then try the opposite ends of the cylinder, so that you will be able to get an idea what amount of lap to put on exhaust side of valve. Keep your crank-shaft brasses hard up, by inserting two pieces of hard wood bevel packing, as I always find the crank side of the brasses to wear the most. With a little care I think you will be able to overcome your difficulty.—Fiber, Dewsbury.

[51998.]—**Brass Whistle.**—The querist can get a fingering scale at any music dealer's. It is practically the same as that of the flute, which I presume he knows, as he adopts the word as his signature.—N. E. Child.

[51999.]—**Steel-Facing Copper Plates.**—The deposition of iron or steel is known as "aciertype." It is, or was, Bradbury's patent, and was worked by them for some years at the office where this paper is now printed. You will, no doubt, find something about Klein's process in Watt or Gore; but if you say what kind of copper plates you mean I will look it up. It is some years since I saw any now; but besides their durability when rust is prevented, they are especially useful where red inks are required, the mercury in vermilion attacking copper with energy.—A Practical Printer.

[52001.]—**Wheel-grease.**—Many others as well as "Simplex" would like a good recipe for making wheel greases, but these are trade secrets the holders of which are not willing to give them up. There are many good wheel greases in the market which can be bought almost as cheaply as preparing them in small quantities. I may say that I have used the spent lubricant for bearings for two years now with very little trouble.—Engineer, Dewsbury.

[52002.]—**New Inman Steamer.**—*The City of Chicago* is 430ft. long between perpendiculars, 45ft. beam, and 33ft. 6in. depth of hold, gross tonnage 5,600. She is divided into eight watertight compartments, and has four complete decks, also a bridge deck 188ft. in length, and a large spread of canvas is carried on four masts. Accommodation is provided for 240 first, 96 second, and 1,200 steerage passengers. The engines are of the three cylinder types, having one high-pressure cylinder 56in. diameter, and two low-pressure cylinders 80in. in diameter, each of 5ft. stroke. The crank and propeller shafts are built of steel, by Vickers and Co., Sheffield, who also furnished the steel propeller blades. Piston valves are issued for the high-pressure cylinder, and all recent improvements have been introduced. Steam is supplied at working pressure of 96lb. by four large double ended and two single ended boilers, having in all 30 furnaces. On her trial trip on 12th September she attained a mean speed of 15 knots. The vessel was built by Messrs. Connell and Co., and the engines by Messrs. John and James Thomson, Finnieston Engine Works.—R. M. S.

[52004.]—**Silk for Flour Dressing.**—Being only a "Country Joiner," I fear you will experience a rather difficult job on what is considered good millwright's work. A reel for 7 sheets "over 24ft. long" between the bearings requires great care in the making, and unless you have had something to do with them before, you must mind how you go to work. Sketches would occupy far too much room for the pages of the "E. M."; however, if you will advertise your address, I will send you particulars.—Millwright.

[52007.]—**Friendly Societies.**—By Section 16, sub-Section 10, of the Friendly Societies Act, 1875, it is expressly provided that trustees shall incur no liability except for moneys actually received by them; and Section 16 generally provides for the investment of the societies' funds. It appears that the trustees of the society referred to in the question are mortgagees in possession, and—that being so—nothing in the Friendly Societies Acts alters their position from that of other mortgagees in possession.—E. F. Brabrook.

[52008.]—**Poor Rates.**—Poor rate is assessed on the real or probable letting value of a house, and if "T. T.'s" house would let for more than the others, it should be assessed higher. If, however, he has a real grievance, he must find out from the clerk to the board of guardians when the next meeting of the assessment committee takes place. He will then have to give notice to the clerk and to the collector that he intends to appeal on that day, and he will then have to attend and state the nature of his claim to the committee.—K. W.

[52008.]—**Poor Rates.**—The rate collector has no right to make a rate or determine the assessment. That is for the assessment committee to do, and his business is to collect the rates. The assessment for rate is five-sixths of the rent the house will command in open market. If, in consideration of a premium, it is let on lease at a lower rent than it would really fetch, that has nothing to with it. The annual value is the amount to be determined. You know your own business best; but I should refuse to pay, and allow Mr. Collector to summon me.—Nun. Dor.

[52012.]—**Bicycles at Night.**—A bicyclist who, instead of a lamp, carries a "flaming torch," deserves a ducking in the nearest canal. Ask your brother bicyclists, and learn something of the amenities of civilised life.—Nun. Dor.

[52012.]—**Bicycles at Night.**—The "Model" Laws read: "Every rider must carry attached to his bicycle a lamp lighted to show a light in the direction he is going," or similar words. If these by-laws are in force, I should say legally a torch is not a lamp; but in any case, no man would be *justified* in any way in throwing you from the machine.—Dozey G.

[52012.]—**Bicycles at Night.**—The various County Authorities have power to make by-laws as to bicycle riding. The following is the general form of clause as to carrying lights:—"Every bicyclist who rides a bicycle during the hours between sunset and sunrise shall carry, attached to his bicycle, a lamp, which shall be so constructed and placed as to exhibit a light in the direction in which he is proceeding, and shall be so lighted and kept lighted as to afford adequate means of signalling the approach or position of such bicycle." Offenders are liable to a fine of two pounds.—Robert Todd, Hon. Sec. National Cyclists' Union.

[52012.]—**Bicycles at Night.**—The law requires you to carry a lamp on your bicycle at night. You were legally wrong in not so having a lamp; but as you carried a torch, it is reasonable to suppose the man saw you coming. He, not being a policeman, had no right to stop you, and if you were injured by being thrown off you could summon the man (if found) for assault. If Mr. Newman was not seriously injured by the fall, I should not advise him to do anything of the sort, as he was clearly technically wrong—even though, perhaps, the man was unaware of it—in riding "without a light," i.e., a lamp *affixed to the machine*, and he might be fined for so doing. The law merely requires you to carry a light for the protection of foot-passengers, who have as much right to walk on the carriage-way as vehicles have to use it. The light being affixed gives you the full power of both hands, whereas in carrying a torch you have the complete use of only one.—G. Russell Pridham.

[52012.]—**Bicycles at Night.**—In reply to G. Newman, the rules regulating lights at night, being made by the different local boards, vary slightly in wording; but, as a general rule, he may consider that the following is the regulation:—"Every bicyclist who rides a bicycle during the hours between sunset and sunrise shall carry, attached to his bicycle, a lamp, which shall be so constructed and placed as to exhibit a light in the direction in which he is proceeding," &c. Bicycle now comprehends tricycle. Strictly speaking, the querist's dismounter could be summoned for an assault; but if I were the magistrate, I should impose the smallest possible fine, as a bicyclist with a blazing torch is most certainly "within measurable distance" of a dangerous nuisance. Why does not the querist use a lamp—they are cheap enough? The above law makes *a lamp* compulsory; but it may be *a light* in some districts. Perhaps G. Newman's lamp failed, and he had to put up with a torch. I hope this was the case; as otherwise his exploit was just one of those foolish and dangerous tricks which bring discredit on all riders of the "steel steed."—B. H.

[52015.]—**Photometers.**—To Rev. T. E. Espin.—I am sorry that "Eta Orionis" has had so much trouble in making a photometer. On reading my description over again, it seemed possible to fall into the mistake which my querist seems to have made, and then, indeed, the prism would be of no use whatever. The passage runs "It consists of a prism placed behind one of the stops of the telescope. It is fastened into the tube of the telescope." What I should have said is that a hole is bored in the telescope tube just large enough to allow the prism to be inserted into the telescope Apex first, while the base is parallel with the tube of the telescope, and fills up the hole. The hole is bored near a stop, of which there are five in my telescope, so that it in no way interferes with the light from the object glass. The lamp of convex is placed outside the telescope close to the prism. "Eta Orionis" might make his prism, as I did mine, out of a thick piece of plate glass. If he can break off a corner neatly he will have all he requires. He will easily be able to tell if he has the right shape, for if he holds it to the sky base upwards at arms' length, and with the base parallel to his line of sight, he should see the sky reflected from the further side of the prism. If he still is unable to manage, and will write to me, I will do my best to help him; but I think he will find no further difficulty.—T. E. Espin.

[52016.]—**Depositing Platinum.**—"E. T. M." can paint his copper foil with a weak solution of platinic bichloride. Afterwards, the foil must be heated, to decompose the bichloride and leave a film of platinum.—Ressorp, F.C.S.

[52018.]—**Portable Engine—One Cylinder.**—I presume that your engine has only one eccentric, and consequently only runs one way. Now, if the valve has neither lap nor lead on steam side, the full throw of the eccentric will be vertically upwards when the crank is on its dead-centre. Therefore, if you place the eccentric with its full throw downwards, leaving the crank still on its dead-centre, the motion of your engine will be reversed; but if the valve has lap and lead, the eccentric will be further advanced. Hence, you must proceed as follows:—Make a mark at the extremity of the eccentric lineable with its full throw, then drop a vertical line cutting this mark. Now, unkey the eccentric and move it forwards until the mark is again cut by the vertical line. At this point the full throw of the eccentric is as much below the centre of crank shaft as it was before above it, which is all that is necessary to reverse the motion. The lead is the amount of opening that the valve gives for the admission of steam when the crank is on its centre, and is obtained by moving the eccentric forwards, the amount of which is determined by the size of the engine, &c.; but in your case you may give it $\frac{1}{16}$ of an inch.—Engineer, Dewsbury.

[52019.]—**Gas Engine.**—In reply to W. Ainsworth, the figures given on p. 224, Vol. XXXVII., were taken from the results of several trials of the engines, the quantity of gas used, power indicated and given out at the crankshaft being known, and from experience in the engines in daily work, and supported by the authority of Dr. Siemens, who stated at the Institute of Civil Engineers (*re* discussion on a paper by Mr. D. Clerk on the "Theory of the Gas Engine") that the fuel was burnt in a cylinder, which it was attempted to keep cool by passing water over it, and it was easy to conceive that the heat so generated was only partly utilised for maintaining the state of expansion of the heated gases, the cold sides of the cylinder taking a good half of it away at once, thus causing a great loss. Prof. A. W. B. Kennedy also said that he had had occasion to work out some gas engine indicator cards. Taking an indicator diagram of a 2 h.p. Otto engine, an average diagram from those taken at the Erfurt trials, and taking the quantity of gas, &c., given in the published results of those trials, he obtained the following results:—

	foot-lb.	per cent.
Mechanical equivalent of heat due to the complete combustion of the gas per (effective) stroke about................	11·000	
Work done per (effective) stroke about......................	2·050	18·6
Mechanical equivalent of heat discharged	3·250	29·5
Mechanical equivalent of heat not accounted for	5·700	51·9

From the judge's report on exhibits, Stockport Gas Apparatus Exhibition, 1882, Class 5, for the application of gas for motive power, trials as published in the *Journal of Gas Lighting*, Oct. 9, 1883, table 4:—

Name.	Nom. H.P.	Dynamometer.	Indicator.	Minutes required to consume 1 c. ft. of gas.	Units of work done 1 cubic foot of gas.
Otto	½	1·074	1·800	1·596	in clndr. 59·35 on flywhl. 37·48
„	6	—	10·600	0·283	in clndr. 70·17
Bisschop	¼	0·270	—	2·060	on flywhl. 13·200
„	½	0·520	—	0·617	on flywhl. 13·96

The ½ h.p. Otto at this trial was consuming at the rate of 38·35 cubic feet of gas per hour, 59·35 per cent. of which appears in the cylinder, or 23 cubic feet of gas, equal to 11,500,000ft.-lb. Of this the engine gave out by the dynamometer 1·074 h.p., or, in actual work, about 2,000,000ft.-lb. The other 9,500,000ft.-lb. must have passed away either by the exhaust or through the sides of the cylinder. The remaining 15·35 cubic ft. of gas was not burnt, but passed through the exhaust. Had this report given the temperature of the exhaust, and the number of revolutions, &c., we should then be able to calculate the exact quantity of heat carried away by the exhausting gases, which, being deducted from the 9,500,000ft.-lb., would show how much passed through the sides of the cold cylinder into the water jacket. See Minutes of Proceedings of the Institution of Civil Engineers, Vol. XCIX., Session 1881—2, Part 3.—R. A.

[52021.]—**Raising Lid of Iron Box.**—Would a weight same as used in window-sashes be of any use?—Watt.

[52023.]—**Apprentice's Overtime.**—You are bound by your indentures of apprenticeship to obey all lawful commands of your master, and if he, by the foreman, says you are to work overtime now, even though you have not been accustomed, you are bound to do so, unless there is a stipulation in the indentures to the contrary. He, not you, is to judge what is the wage to be paid. If you could give more particulars, I should be better able to answer your query.—G. Russell Pridham.

[52024.]—**Recovery of Sulphur.**—I cannot give a description of the plant required; but should think that the spent oxide need only be agitated with CS_2 in a covered vessel; then decanting the solution off into a retort, from which the CS_2 is subsequently distilled, leaving the sulphur behind. A low temperature must be used, and the distilled CS_2 may be condensed for further use. Could not the spent oxide be utilised for the manufacture of vitriol?—Ressorp, F.C.S.

[52028.]—**Wimshurst Influence Machine.**—I have made one in which the axle is made of ebonite, turned true. Each plate has a wooden cap cemented to it (with the cement sold for sticking glass, &c.), with a hole bored in for the axle. The caps must be turned flat, and the glass stuck on flat, else the plates will touch as they revolve. The plates are made to revolve in opposite directions by crossing one band.—Watt.

[52029.]—**Ebonite.**—You can flatten your plate by pouring hot water over it till it gets soft, and then clamping it between two flat boards till it is hard.—Watt.

[52030.]—**Photographic.**—Under the circumstances described (I speak from experience), I should say a yellow glass would answer every purpose, though as an additional precaution it might be advisable to have some sort of blind or curtain that could be drawn over the windows either in whole or in part, as the varying conditions of light may appear to render necessary.—W. Robinson, Jun.

[52030.]—**Photographic.**—I would strongly advise "Ruby," if he cannot get sufficient light to develop his negatives with, through ruby glass, to use a lamp. I have done this for some time past, and I find it answers very well; the lamp being really not half so troublesome to look after as one would think. Yellow glass, such as would be suitable to work wet collodion plates by, would completely spoil any dry plates.—Machina.

[52031.]—**Dynamo.**—The resistance of your armature should be about the same as field-magnets. The distance between the armature and field-magnets is too much; it should be as near as possible without touching.—Watt.

[52031.]—**Dynamo.**—From description, I think the wires must be connected up wrong. Wire from brush should go round first half of magnet, then cross, and go round other half in a contrary direction, thence to lamp, and back to remaining contact brush. It is difficult to say what is wrong without examining the machine; but if "Labor Omnia Vincit" fails to make it work, I shall be glad to help him if he will send me a sketch of machine and connections.—Light.

[52038.]—**Boiler.**—You will be no saver by reducing the pressure in your boiler from 70lb. to 30lb., but rather a loser. The proof is in the fact that a given weight of fuel will evaporate a given quantity of water, irrespective of its pressure or temperature. Therefore, it must be obvious to anyone, that steam at 70lb. will be drier than steam at 30lb., since to generate a given volume of steam less water will be required for that at 70lb. than that at 30lb.—Engineer, Dewsbury.

[52041.]—**Brush Dynamo Machine.**—I think Williams has connected up the coils of dynamo wrong, and the current in lower coil neutralises current in upper coil. Try connecting the inside end to outside end of opposite coils.—Light.

[52048.]—**Oxychloride of Mercury.**—The most simple test is that of volatilisation on heating—any residue indicates the probable presence of tin, bismuth, or lead. The bichloride is soluble in water, sulphuric ether, and rectified spirit. If "R. W. J." would like to know what impurities are present, I would readily examine his sample if he will advertise his address.—Ressorp, F.C.S.

[52048.]—**Oxychloride of Mercury.**—All combinations of mercury with *volatile* acids are entirely dissipated by heat. There are three chlorides of mercury found in commerce—viz., "calomel," or mercurous chloride; "corrosive sublimate," or mercuric chloride; and "white precipitate," which is mercuric ammonio-chloride. I suppose "R. W. I." refers to one of these; however, they are all entirely volatilised below a red heat, and a residue would certainly be an impurity.—W. E. Haden.

[52051.]—**N.B.R. Locos.**—As this query has been answered before, I will only give a few principal dimensions of these bogie express engines:—Diameter of cylinder 18in.; length of stroke, 26in. diameter of four-coupled wheels, 6ft. 6in.; total heating surface, 1,100 sq. ft.; weight of engine, 44 tons; water capacity of tender, 2,400 gallons. There are 12 of these engines, four being stationed at Glasgow, Edinburgh, and Carlisle respectively. Concerning the single engines, "Glasgow" and "Berwick," about which a query appeared on the 5th, I can only say their cylinders are the same size as the bogies, and their driving wheels are 7ft. in diameter.—W. Thompson.

[52051.]—**North British Engines.**—The North British Company's coupled bogie express engines, which convey the Midland Scotch Joint Stock trains between Carlisle and Edinburgh, were designed by Mr. Drummond. They have cylinders 18in. diameter, with 26in. stroke, and as the wheels are 6ft. 6in. diameter, the tractive force is thus

$$\frac{18^2 \times 26}{78} = 108\text{lb.}$$

or 108lb. exerted for each pound of effective pressure per square inch upon the pistons. The engines are all fitted with the Westinghouse brake. It may be mentioned that the Glasgow and South Western Company has also some powerful express engines to convey the Glasgow portions of the same trains between Carlisle and Glasgow.—Clement E. Stretton.

[52054.]—**To "Vulcanite."**—All the questions asked in this query are explained and answered in the book I named in my reply to 51346 on 14th September.—Vulcanite.

[52054.]—**Flute.**—The proper places of side holes on a flute depend upon so many "fine points," and would take up so much space, that I must advise "Constant Reader" either to wait until "Vulcanite" arrives at that point, or obtain the book before alluded to (see page 42). Opinions differ as to which is the best—the cylinder, or the taper bore. Boehm, the great flautist and flute maker, believed in a cylinder bore, with parabolic head joint. I am sorry I cannot help "C. R." to the best form of tool for taper-boring; but, for a cylinder bore, I have pleasure in recommending him to the article by Mr. Evans in this our valuable paper, Vol. XXXIII. No. 848, page 368.—Old Blow Hard.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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51373.	Bourdon and Windchest, 562.
51377.	Crumpets, 562.
51378.	Malt Bread, 562.
51390.	Waste-Water Meter, 563.
51396.	India Vats, 563.
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51404.	Sounding, 563.
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51421.	Microscopical, 561.
51422.	Mange, 564.
51423.	Marine Dredge, 564.
51427.	Gilding German Mouldings, 564.
51429.	Centrifugal Pump, 564.

51622.	Chemical, p. 45.
51627.	Removal of Chimney Shafts, 45.
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51652.	Aniline, 46.
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51661.	Argelander's Star Chart, 46.
51663.	Short's Speculum Metal, 46.
51668.	Staffel's Calculating Machine, 46.
51672.	The Australian Colonies, 46.
51677.	Sleeping Carriages, 46.
51678.	Spiral Turning, 46.
51691.	Australia, 47.

QUERIES.

[52060.]—**To "Fellow-Workman."**—I had a mainspring to put into a lever watch the other day, and succeeded in putting it in with my fingers—after some failures—and after having my fingers severely scored and blistered. I believe there is a machine for doing this work, and would be glad if you would inform me how to use it after I get it, and if the spring is wound direct into the barrel, or how? Just before this I had another lever with a broken hairspring—a coil wanting—watch spring above. I got roller and rolled off all right and new spring on, in all respects as nearly like the old spring as possible, only with full number of coils. Spring was perfectly flat and free all round, and tight on collet, yet when balance was put in, watch would not keep going: seemed to me as if the spring itself had brought the wheel to a stand. I could not see what was wrong and gave it up. Do you think you could point out where I had gone wrong, and earn the gratitude of—Scotus.

[52061.]—**Medical.**—For some weeks I have been suffering in my ear. It first inflamed and was very painful. Then a discharge commenced, and the pain subsided. Our family doctor instructed me to syringe it with warm water and drop in tannate of glycerine. He now tells me that there is a growth in the meatus very near to the tympanum. This I suppose is polypus. He dug some of it out, and told me that if it should not be better in a few days he would send me to an aurist. I believe these things are often very difficult to get rid of. I shall be glad to know if there is any method of curing polypus, except by surgical operation. Is there any solvent or drug that will destroy the fungus? I have read that sulphur is inimical to every form of fungus life, and that it has been used, as a gargle, successfully, in cases of diphtheria. I shall be very much obliged for advice, as bathing and injecting two or three times a day is very inconvenient, to say nothing of the pain, which is sometimes severe. I may say that I am otherwise in good health.—Salvo Jure.

[52062.]—**End Bearing for High-Speed Spindle.**—An upright spindle of hardened steel, ⅜in. diam., with a rounded end at bottom, bears on the end of a hardened steel plug, which is similarly rounded, and a well of thin machine oil surrounds the bearing. The weight supported by the bearing is about 40lb., and the speed of the spindle is 7,000 per minute. The bearing is unsatisfactory, as the surfaces heat and tear each other somewhat, the spindle remaining roughly convex, while, the end of plug becomes concave. I think the oil is forced away from the bearing by the pressure and the high speed. Would matters be improved by using different metals for the bearing by altering the shape of the surfaces in contact, or by employing a thicker oil such as vaseline? The bearing surfaces are very hard, and are immersed in the oil.—Centrifugal.

[52063.]—**Feed-Pump.**—What pressure would there be in a pump working at 150 strokes per minute, with a boiler pressure of 130lb. per square inch, the diameter of the ram 2in., stroke 24in., diameter of feed-valve 2¼in., diameter of delivery-valve 2½in., supposing the pump to be ¾ full at each stroke?—Pressure.

[52064.]—**Exhaust.**—Can anyone give me a simple rule for finding what distance the piston has travelled when the slide-valve opens to exhaust? I cannot work out the rule given in Molesworth, as I cannot do trigonometry.—Pressure.

[52065.]—**Dulling Nickel Plate.**—Can any tell me how to dull a nickel-plated article, so as it of a dead blue or black colour? I fancy the acid, or mixture of acids, which will effect this. Graph.

[52066.]—**Brazing.**—Can anyone inform m modus operandi of brazing with atmospheric gas? made a fan and connected it with the gas by m ½in. indiarubber tube, but cannot get sufficient special burner required? I am making a tricycle, and several parts must be brazed on frame which I cannot get on the forge.—Cyclist.

[52067.]—**Paint for Tin Pots.**—Can anyone tell me of a good, durable, elastic paint or varnish for the purpose of coating ordinary tins with, so as to prevent their being corroded by the action of saline solutions even after continued use? It is of great impertance that it should adhere firmly, not be troublesome to use, and not expensive. Have tried a mixture of pitch, paraffin, and marine glue, but it becomes soft, buckles up, and is liable to be scratched off.—P.

[52068.]—**Fairy Lamps.**—Can any correspondent tell me from what source the fairy lamps in theatres are lighted—whether from a small secondary or primary battery?—and what metals are the elements?—P. Y. C.

[52069.]—**Metropolitan Building Act**—Does section 92 give a building owner who has paid the whole cost of a party wall, an absolute lien on it, so as to enable him to make the landlord of the adjoining house pay his tenant's share of, or to get same from a new incoming tenant? I have rebuilt my house, which I will call 40, Blank-street, and the party wall between my house and No. 30 being very defective and out of upright, has had to be rebuilt from including the foundation, and I have paid for the whole of the work, having been unable to get anything out of B., the owner of No. 30. B. has since failed, the estate showing, practically, no assets, and his house is now taken by C., who is making alterations, which evidently involve cutting the wall about, as brick and cement rubbish, is being carted away. Can I stop C. doing anything to the wall until he has paid B.'s share of its cost? The exact amount for which B. was liable is not yet settled, as the arbitrator has not given in his award.—Horloger.

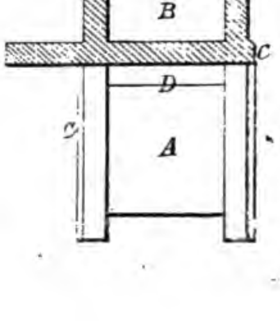
[52070.]—**To "F.R.A.S."**—Is δ (delta) Cygni a good test for 4½in. achr.? I split it perfectly in moonlight, and find the colours well contrasted.—C. J. R. Ventor.

[52071.]—**To "F.R.A.S."**—(1) Must we infer from the presence of chipped flints in the Brixham caverns, either that human beings lived in those cavities together with the bears and hyænas, or that the flints were carried thither by those animals after being wounded by them? (2) Could a jagged flint be forced by human hands through the thick skin of a bear? (3) Is it unreasonable to suppose that the flints were caught up by the hair of the prey of the bears and hyænas as they were being dragged to the caverns over ground strewed with flints? (4) If flints did thus attach themselves to the animals that were devoured, would they not sometimes be "crunched" by the devouring animals, and would not the strong jaws of the hyæna break them into smaller pieces than would those of the bear?—and would not this account for the difference in size between the flints in the upper and lower layers of the Brixham cave?—K.

[52072.]—**Crayfish—Where and When to be Found.**—Some months ago, a correspondent told us in your best of science magazines that in early autumn those agreeable little pseudo-lobsters, crayfish, were to be found in every rivulet of running water, brook, and river. Alas, Sir, in what region of the blessed are these fertile waters to be found? I am living in North Devon, amidst trout-full streams, grilse-teeming floods, and salmon-visited noble rivers, yet never did I see a single specimen of a crayfish in these waters. Why?—R. Enis.

[52073.]—**Penang.**—Will some of ours kindly give me any information they can, respecting the above island as to climate, cost of living, kind of clothing required, &c.? The names of any works on this subject will oblige.—Am Emigrant Teacher.

[52074.]—**Lathe.**—(1) Can any of your readers help me in making a pattern of a lathe bed? The only way that I know of, is to make the pattern solid and have core boxes. The trouble principally is the border C round the bottom edges, the recess B, and the webs A on each side of the gap. B is for the bolts to screw the standards (German pattern) on with. The lathe is a 5½in. centre screw-cutting gap bed lathe, and intended to turn 24in. diam.; and I wish to know how thick the bed should be—would ¼th be enough? The bed is over 5ft. long, and to avoid a long crankshaft the standards are placed 4ft. apart, the bed overhanging about 20in. or more. Therefore, the shaded portion in the sketch occurs again, 4ft. from the mandrel end, and that adds to the trouble. The line D is the bottom of the gap. The



wi.h to

protection order), without the husband's receipt? The testator died last year.—Dubious.

[52 76.]—**Wood Pulp.**—How can I make wood shavings and cuttings into a soft pulp?—Paper.

[52077.]—**Machine Drawing.**—Will any correspondent (one who has undergone examination, if possible) oblige me by giving me a few hints about practising machine drawing for the Advanced stage of the Science and Art Department Examinations in machine construction and drawing? I have the knowledge of machine details required, I believe, and I have copied a few working drawings of machines; but the dimensioned sketches of the examinations I could not, when in the room, manage properly. Please do not refer me to Maxton, as I have read it. What I seem to want is practice; but I do not know how to go about it.—Engineering Student.

[52078.]—**Granule Battery.**—I should be glad if any subscriber could tell me if the old crushed carbon in the above cell can be used again for recharging the cell, as I find it expensive to recharge always with new?—P. Y. C.

[52079.]—**Watercloset**—Would any of the readers of your valuable journal kindly assist me in the following?—I took a house a few months ago, in which there are two w.c.'s worked by a force-pump. All are out of order, and have been for some time On examining the soilpipe from w.c.'s, I find there are small irregular holes in it, extending at intervals throughout most of it and all on one side. Can they be caused by corrosion or by rats, as there are traces of them? I have been recommended to put glazed sewerage tile pipes in lieu of the old lead one, which is from 26 to 30ft. in length;—would the former last long, and what would be the probable cost of them? I wish to try and repair all with the aid of a good carpenter, as plumber's charges to come here would be exorbitant. I should be glad of the name of any book that would give me intelligible instruction on the above subject.—Aqua.

[52080.]—**Water Main.**—Our waterworks are about to supply a small village about three miles from works. It is proposed to make connection close to pumps on a 20in. pipe, by taking out one pipe and putting another in its place, with a connection and valve, so as we can send water to them when required. Will any of our readers tell me how to proceed to take pipe out and put another in its place?—must I take sledge and break pipe, and must the new pipe be shorter than the one taken out?—if any, how much?—Turncock.

[52081.]—**Marks on Silver Plate, &c.**—Can any correspondent inform me what is the difference, if any, in the fineness of silver jewellery sold as (1) fine silver. (2) real silver. (3) sterling silver. (4) standard silver? And also whether the mark of "a lion passant" is the mark of the best quality of silver?—J. H.

[52082.]—**Contents of Box.**—To. "St. Aubyns" and Others.—A sack measuring 5ft. 1in. in circumference and 3ft. 6in. in length, will hold, when full, 18 stones weight of wheat (14lb to the stone). Wanted to know, of what height must an oblong box be made, being 2ft. 11in. long by 2ft. 6in wide, and having the whole of the bottom sloping longway in from back to front at an angle of 40°, to hold the same quantity of wheat?—Contra.

[52083.]—**Punching Machine.**—Having seen the other day a large punching and shearing machine at work, I wondered how the makers arrived at the pressure required to punch a certain plate. Now the hole which I saw punched was 2in., and the thickness of the plate, which was of steel, 2in. What pressure in tons wou'd it require, and how is the calculation made?—Crado.

[52084.]—**Building Society.**—Would the committee of a building society have power to impose continued subscriptions after a borrowed share had attained its full value, in order to create a surplus fund, nothing to that effect being in the printed rules furnished to the members at the time of joining the society?—Working Man.

[52085.]—**Building Society.**—I am a borrowing member of a building society, the shares of which are £60, for which I have to pay £3 per annum as subscriptions, and £3 as interest, and 3s. 6d. expense fund per annum. I should be glad to know how many years I have to pay the subscriptions and interest before the property would be clear of the mortgage, and the shares realise the value of £60. If there is a rule how to calculate same, should feel much obliged if some subscriber would kindly give it.—Working Man.

[52086.]—**Learning the Zither.**—Will some reader kindly say if this instrument is a difficult one to master, and if it can be learnt by the aid of an instruction book only?—Ignoramus.

[52087.]—**Pressure on Crank Pin.**—Would "Engineer, Dewsbury," or "Firer, Dewsbury," kindly help me with the following?—What will be the pressure on the crank-pin of our Macnaughted beam engine, when the crank has moved through an arc of 45° from the top centre? The effective pressure in the h.p. cylinder at this point is 62lb. per square inch, and in the l.p. cylinder 18lb. per square inch. Diameter of h.p. cylinder = 18½in. by 2½ft. stroke, and the l.p. cylinder = 25in. diameter by 5ft. stroke. Revolutions per minute 40. The weight of the transmitting parts is, say, four tons.—H. N.

[52088.]—**Black Stain.**—Will any of ours kindly oblige a constant subscriber with a permanent black stain for cork wood that will withstand hot or cold water?—Cork Wood.

[52089.]—**Frosting Tin Tubes.**—By what process is a frosted or crystalline appearance given to tin tubes, such as are used in kaleidoscopes and other instruments?—P. M.

[52090.]—**Telegraph Instrument.**—Having con- [illegible]ted and fixed a set of small telegraph instruments— [illegible] of simple key transmitters, and a pair of [illegible]dle instruments, the way I have them con- [illegible] one of the keys is only the distant [illegible]d of both the needle instruments [illegible]der may see what he is sending. [illegible]m on the latter plan (no earth [illegible]nt Subscriber and Reader.

[52091.—**Engine Query.**—How can I know when an inverted cylinder engine is at rest (with and without reversing gear), which way the shaft will revolve when the steam is applied? A little explanation on the subject will be thankfully received. Please do not refer me to back numbers.—L. M. B.

[52092.]—**Lake Strangford.**—What is the superficial area, in acres, of Lake Strangford in Ireland?—also of the Zuyder-Zee in Holland?—A. Z.

[52093.]—**Load on Columns or Stanchions.**—The formulæ for calculating the above suppose that the pressure passes down the axis, or that the pressure is symmetrically distributed over the sectional area. But in practice this is not always the case. What correction should be made when the pressure passes down a line at any distance from the axis?—J. S. C.

[52094.]—**Lost Watch Wheel.**—To "R. E. D."—Many thanks for your reply to my query. I would also ask you what sort of acid is used for dipping any article into after hard soldering? Again, what is the reason of a clock going fast when it is newly wound up, then slow, when it has run about five days?—seven-days going barrel. Is mainspring at fault?—Hall.

[52095.]—**The Vienna Refractor.**—Have any particulars been published of the performance of Grubb's 27in. refractor? By this time something should be known as to its merits. Perhaps some of "ours" can enlighten me. I should also be glad to know whether there is anywhere published a list of the leading telescopes now in use in the principal observatories, giving the aperture and focus of each, together with the makers' names.—Achromatic.

[52096.]—**Vibrations of a Magnetic Needle.**—A magnetic needle balanced horizontally at its centre upon a firm point, makes 11 vibrations in 2 minutes 1 second at a place A, and 12 vibrations in 2 minutes at a place B. Compare the strength of the earth's horizontal magnetic force at the two places, explaining clearly how you arrive at the result?—W. S.

[52097.]—**Vibrations of a Magnetic Needle.**—A small magnetic needle suspended horizontally by a silk fibre makes 100 vibrations in 5 minutes 36 seconds, under the influence of the earth's magnetism only, and 100 vibrations in 4 minutes 54 seconds when a horizontal bar magnet is placed with its centre vertically below the needle, and with its axis in the magnetic meridian. Compare the magnetic force exerted upon the needle by the bar magnet when in this position, with that exerted upon the needle by the earth?—W. S.

[52098.]—**The Torsion Balance.**—Two straight pieces, one 3in. and the other 5in. long, are cut from the same narrow strip of steel. After being equally magnetised, they are hung horizontally, one at a time, by the same fine glass thread, so as to rest in the magnetic meridian when the glass thread is not twisted. On turning the upper end of the thread half-way round (through 180°) the shorter magnet is deflected ten degrees from the meridian. Show how much the upper end of the thread must be turned to deflect the longer magnet ten degrees?—W. S.

[52099.]—**Agricultural.**—Thanks to "Farmer." Will he now kindly give me the value of permanent pasture—that is, what sum an outgoing tenant, who has laid down permanent pasture fairly well, ought to receive from his landlord as compensation, that compensation being, I should say, the increased value of the land to the incoming tenant? I think the average mangold crop in Hants (South), would scarcely be so much as 30 tons per acre, but that the average price per ton would be £1, that is in heap.—Estate Agent.

[52100.]—**Electrical.**—(1) Will someone who thoroughly understands batteries, say if a one-cell quart, half-full, bichromate battery, three carbons and two zincs, each 2in. square, would render the platinum wire of a lamp to be lighted by electricity, incandescent?—and if so how long would the solution last, the zinc being withdrawn except when pressed into the cell to generate the current, and only used, say, once a day? (2) Would two carbons and one zinc, same size as above, do the work required, conditions as above?—R. Hannen.

[52101.]—**Induction Coils.**—Will any reader kindly answer the following questions? (1) Would the power obtained from a coil containing 1,000yd. of No. 3? silk-covered wire be as great as or less than one containing the same quantity of No. 38? (2) How many five-plate cells of a bichromate battery would be required to obtain the full power of the coil of No. 38 wire, as described above, the carbons being 7in. × 3½in. × ¼in.? (3) I want to place a water regulator horizontally in the inside of a coil and have a vertical contact-breaker, and have the connections the same as the contact-breaker, with the iron bundle for the magnet. Will this answer? (4) Is it necessary to have a bundle of wires in the coil if it will?—Invicta.

[52102.]—**To "F.R.A.S.," Mr. Holmes, or Other Astro. Friend.**—A series of popular papers, suggestions, or hints on the construction, mounting, and mode of using a handy but efficient form of a student's equatorial would be appreciated, I am sure, by many of our amateurs. The price usually charged by opticians is too often prohibitive. I feel sure, to many of limited means full description, with drawing of "divided circles," suitable to a 3in. or 4in. aperture, with directions for setting them on the instrument, would no doubt enable many an amateur to provide himself at little cost with this useful, and in some cases necessary, appendage for practical astro. work—Vigilans.

[52103.]—**Engine.**—Would "Engineer, Dewsbury," or "Labor Omnia Vincit," help me out with the following? If steam at 60lb. by gauge is used in a compound engine, and each cut-off is at half-stroke, the low-pressure cylinder being four times the volume of the high-pressure one: required the pressure of steam at points of cut-off, final pressure, and back pressure, and also the number of expansions, and what part of stroke must I cut steam off in a single-cylinder engine to get the same number of expansions as in compound engine? Vacuum by gauge 13lb.—Young Enginesman.

[52104.]—**Removing Veneer.**—Will any reader give me a little help with the following job? I have part of the frame of an old piano which is veneered or laid with walnut. This I wish to remove so as to use it again; but I wish to get it off bodily without damaging the face—which is very smooth and glossy. How must I proceed?—Engineer, Dewsbury.

[52105.]—**Cutting Circular Glasses for Chromatropes.**—Can any reader tell me of a simple method of cutting glass for the above?—Chemicus.

[52106.]—**Jacquard Loom.**—Will any reader kindly tell me if there is a jacquard loom which weaves the weft in a circular manner across the warp—i.e., instead of of lying straight across, it is made to be, say, 2in. or so nearer the beam in the centre than at the two edges? If there is not, could such a thing be done, and by what means could it? Is there any book to be had which might give me the desired information?—J. A. S.

[52107.]—**Toning Bath.**—I purchased a bath containing sufficient chloride of gold to tone eight sheets of paper. After once or twice using I find I cannot get a good colour in toning—only a dirty brown tint. How can I alter this? How long should prints take to tone as a rule? My last have been in 8 or 10 hours, and then are not really a good colour.—Dozey G.

[52108.]—**Integral.**—Will some reader kindly show me the method of obtaining the general integral of the equation—

$$\frac{dy}{dx} = \frac{d^2u}{dx^2} = \frac{u}{a^2}$$

Rankine states it to be—

$$a = Ae^{\frac{x}{a}} - Be^{-\frac{x}{a}}$$

("App. Mech.," p. 175).—Vis Viva.

[52109.]—**Lathe.**—Will "Nun Dor.," "Os," or some of our practical readers kindly instruct me how to fit a pair of 3½in. centre back-geared lathe heads up? I am a poor man, and cannot afford to send them to a first-class fitting shop. How is the gear-wheel made fast to mandrel, and what diameter of thread should I have on the mandrel nose? All particulars how to fit the above up will oblige.—Miner.

[52110.]—**Mangle Rollers.**—Will some kind reader inform me how to select wood, turn, and fit spindles to mangle rollers?—Iron.

[52111.]—**Drilling up Balance Staffs and Pinions without Softening them.**—Is it possible to drill up an English balance staff or pinion without softening them? I have been told such can be done; but although I have made drills of the best steel, I cannot do it. I should like to know if it is usual in the trade, as it appears to me to be impossible, since all the staffs and pinions I have come across that were pivoted were softened.—Hard Steel.

[52112.]—**The Sun's Distance.**—I find from a textbook on astronomy that the apparent diameter of the earth when nearest to, and seen from, the sun is 17·86". Can this be ascertained without first knowing the sun's distance, and if so, could not the sun's distance be found with considerable accuracy by finding (thus $\frac{360°}{17·86''}$) the number of earths it would take to form a ring round the sun at the distance of the earth when nearest to it? This number, multiplied by the earth's real diameter and divided by 2π would furnish in miles the distance of the sun when the earth is in perihelion. The result, using the earth's equatorial diameter, is 91,545,478 miles nearly. If, on the other hand, the knowledge of the approximate distance of the sun is required in order to calculate the apparent diameter of the earth as seen from the sun, could not this method be used to find, more accurately than has hitherto been done, the distance of a planet—as seen from which the apparent diameter of the earth can be calculated, irrespectively of knowing the planet's distance,—and then this distance be used as a base line for finding the sun's distance? Information on these points will be gratefully received by—A Young Star-Gazer.

[52113.]—**Magnetism.**—Will some of your readers kindly work out the following? A mariner's compass is placed on a table and a bar magnet is laid on the floor below it, the centre of the bar magnet being straight underneath the centre of the compass needle. When the N.-seeking end of the bar magnet is northwards, the compass needle, after being disturbed, makes 100 oscillations in 16 minutes. When the N.-seeking end is southwards the compass needle makes 100 oscillations in 12 minutes. When the magnet is removed, so that the compass needle oscillates under the influence of the earth alone, how long will it take to make 100 oscillations?—Young Student.

[52114.]—**Painting Windows in Oil.**—Is there any means by which a window can be painted in really transparent oil colours? Would varnish answer as a medium, and if so, what varnish? I have tried Judson's dyes in water-glass, but find the mixture, from some reason, spoil the colour—magenta becoming a muddy reddish purple.—Achespe.

[52115.]—**Bramah's Press.**—Can any correspondent tell me what tubes are most used to convey steam into the plates of a Bramah's press when used for finishing textile fabric? I now use indiarubber and canvas. I have heard of flexible copper tubes being used. I should like to know how attached and where they are to be got? Please send sketch of attachment.—Subscriber.

[52116.]—**Legal.**—(1) When a person buys a business from another, but takes the house at quarter-day, is he responsible for the poor, gas, or water rates if the former tenant left them unpaid? If so, can he sue the former tenant for them? (2) What is the correct proceeding to take when a lodger does not pay his rent, and you want your money?—T. A. R. T.

[52117.]—**Legal.**—B. dies in Cape Colony, and leaves L. and her family all his possessions, which are both fixed and movable. Before B. died he made a will and entered it in the High Court of the Colony and an executrix to communicate with L. How long can she keep the movables before sending them to L., or can she dispose of any property without consulting L.? She has a percentage on all money that comes to L.—A Constant Reader.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 24, and unacknowledged elsewhere:—

Blakey, Emmott and Co.—W. Wright.—Edmund Broderip.—T. Trower.—J. and W. E. Archbutt.—Rev. S. R. Craig.—Castor.—Volt.—A. R. Wilkinson.—W. B. P.—G. Hartley.—James Edwards.—London River.—W. H. Richmond.—T. B.—Practical Chemist.—E. B. Fennessy.—Lincoln.—G. D. Goold.—Hemisphere.—W. A. Felton.—R. J. Walsh.—R. Bolton.—Markwell.—Ivanhoe.—A. V. Nicholls.—Inexperienced.—J. I. S.—Ixion.—E. R. D.—Colonial Collier.—Rev. J. J. M. Parry.—A Seven Years' Subscriber.—W. Limont.—Platinum.—C. Gandibert.—Vulcanite.—H.—G. A.

M. Piper. (Impossible to explain first query without knowing connections. 2. Pitch, treacle, sugar, rosin, and other carbonaceous substances.)—Mechanic. (Frequently answered. Harmonium reeds cannot be used in the tubes of an American organ, and are not advisable in any suction instrument.)—Ebo. (A magnet will operate the tap, and a coil of platinum wire rendered incandescent, or a spark passed between two points, will light the gas. See indices. 2. Pieces of wire soldered in.)—Stargazer. (Very doubtful. It depends on the quality of the o.g. An optician would tell you in a moment after inspecting it.)—Paddy. (Illustrations of two sledges on pp. 333, 337, Vol. XXXIV.)—Anxious Inquirer. (Procure Bagster's list, and the catalogues of other publishers.)—Invicta. (They are sure to fade in light to a certain extent; but they might be preserved by varnishing.)—J. Harris. (Use iodide of potassium. See any handbook of the art.)—A Weary One. (We know of nothing better than soft water and good soap.)—J. P. R. (The specimen sent leaves rather more red stuff on the paper than is pleasant, and is scarcely efficient as an eraser. Warmth would soften it temporarily; but we are afraid your stock is useless, except for reworking at the factory.)—Dark Blue. (Properly, black sulphur is the crude native sulphur; but refuse from the subliming pots is often substituted for it. The latter is poisonous from the quantity of arsenic it often contains.)—Aurora. (We thought quite enough had been heard of the experiments. There is nothing special in the motor, which is a common form. Any results which may be superior are produced by the method of winding and by the construction of the magnets; but the question is whether any superior results have been obtained.)—Leo. (Similar questions have been answered many times, with illustrations. See the indices, and read the present series of papers.)—W. H. C. (There is nothing very special in the method. Prepare the foundation with broken brick, &c., and then put on a layer of small gravel stones coated with tar. These stones are first thoroughly washed, and then coated with tar, which has been boiled to evaporate all the water. This layer is rolled down, and is then floated with a coat of hot tar, which is covered with sand or chips of fluorspar and rolled.)—Amateur Smith. (There are several methods in back volumes. Coat with borax or plaster of Paris to weld, and dip when at a red heat into salt and water to harden.)—T. H. (There is no book on the subject, and it is almost a lost art. The shell is joined by heating, and the smoothing and polishing done in the ordinary way, with glasspaper and crocus or rouge.)—Plasterer. (See p. 445, Vol. XXXVI., and the indices generally.)—Sol Fah. (Procure one of Novello's catalogues. The address is Berners-street, W.C., and you will find several works on the subject. Don't practise with set pieces; but exercise, whenever convenient, with the simple scale, keeping well within your limits. You will thus strengthen and improve the voice, and the rest will come in due course. If you have not patience for that, you may ruin it.)—S. L. W. (If it is ordinary putty, it will soon yield to a strong solution of caustic potash applied with an old brush. Mind your fingers. If the putty is a mixture of white and red lead, it will take longer to soften it.)—Amateur. (If you will say what you mean by a "solution of *the* salt of gold," we shall be able to tell you. Which salt do you mean?)—A Lover of Ours. (Read up what has been said in back numbers about small dynamos. It is impossible for us to find room for all the queries which reach us from those who are anxious to make small dynamos and motors without having even an idea of the construction.)—Cam. (Most of the publishers who issue educational works can supply you. There is a cheap work of the kind in Collins' Advanced Series.)—J. C., Ten Years' Reader. (Rock-salt will kill weeds, if you apply enough; but you would find a strong solution of sulphuric acid more useful.)—Plater. (It was described at length by Mr. Sprague on pp. 1, 45, last volume. There is no better battery than a Daniell for general electro-metallurgy; but the Smee cell is sometimes preferred.)—Porridge Pan. (Use something like a gluepot, one vessel inside another.)—M. A. S. (No; there is no obligation to accept a lowest tender.)—Subscriber. (The family name of the Queen is generally said to be Guelph.)—Rev. S. Mills. (It is not so bad as all that, and we cannot spare the space to repeat. If you and other astronomical correspondents would kindly make your diagrams black upon white, and not white on black, just like the second diagram sent, there would be no difficulty. The difficulty is as much in the working as in the engraving. The "E.M." is necessarily printed rapidly, and small spots in the middle of a dark field soon fill—some readers, of course, getting better-printed copies than others.)—C. Wood. (Printed copies of all published specifications can be bought at the Government Patent Office, Southampton-buildings.)—Joseph Seel. (We could not spare space, or avail ourselves of the arrangement suggested.)—J. McD. (We should sue them in the County-court for the sum paid.)—Pearl. (We cannot go into commercial matters.)—Baritone. (Neither indulgence improves the voice.)—Longfield. (1. Occasionally missing the draught would not matter much. 2. A very common thing, and not at all due to the cause mentioned.)—A. Stanley Williams. (Thanks, but we have not room this week, and next it will be too late.)—H. B. Flockton. (If practical, and not too long, we could publish them.)—John Hampden. (Not a bad idea; but a general invitation would bring so many suggestions from people ignorant of what had already been attempted, that we should tremble for our space. Have you ever had to search at the Patent Office yourself? If so, you must have been struck with the numerous abandoned inventions in various branches of manufacture of which you were previously ignorant.)—G. M.—(For information about goitre, or Derbyshire neck, see pp. 271, 340, 390, 463, 539, Vol. XVIII.)—Science. (Procure catalogues from Macmillan and other publishers. You do not specify the district.)—Aeronaut. (The cheapest method is to pass steam through a tube containing red-hot iron borings. Calico would do if treated with suitable varnishing coats, but silk is better.)—S. T. J. (See p. 120, Vol. XXXIV., and the indices generally. The water ought not to boil at all, but to circulate as soon as it becomes hot. Mr. Eldridge, 54, Murray-street, Hoxton, N., publishes a guide.)—An Anxious Parent. (See Dr. Edmunds's remedy on p. 430, No. 903. See also pp. 562, 583, 607, Vol. XXVI.)—Amateur Beekeeper. (You should procure one of the cheap handbooks on the subject—say Rusbridge's, published by Allen, Ave Maria-lane, E.C., 1s. 6d.; or look up the subject in back volumes. All sorts of devices have been described.)—John R. Rhodes. (See p. 289, Vol. XXXVI. The weight that must be carried is too great, and as an "auxiliary" would be altogether out of place.)—Oswald Twistle. (It is impossible for us to discover which articles you mean by the simple reference "a good while ago." Perhaps you mean the article on p. 353, No. 926.)—Economist. (If we understand you, the only way is to obtain a proper portrait lens. A good deal can be done by lighting the sitter, and if you have a Merveilleux, you ought to have no difficulty in making very good portraits indeed.)—Indefatigable. (Both queries answered many times. For full instructions in French polishing see pp. 175, 227, Vol. XXXII., and the indices generally for many references. 2. It is spread on tinfoil, and the perfectly clean glass slid on and weighted down.)—Iron. (The "spelter" is a softer brass than the parts to be joined. See back numbers for full directions in brazing. 2. For grinding skates, see p. 16, No. 833; p. 527, No. 828.)—A Sufferer (P'boro). (Dr. Edmunds has replied at length; see p. 209, No. 919.)—Tinteretto. (Leclanché, if you want them for such work as bell-ringing; but if for power, Bunsen. 2. The best soft iron rod will do; but it should always be made red-hot, and allowed to cool very slowly. 3. Sprague's "Electricity" (Spons); new edition coming out "soon" or "shortly.")—Tempo. (The aneroid barometer is described in many textbooks and cyclopædias. Such records have been kept for years, but we do not know what use they have been.)—Sapo. (There is one by Ott, and Messrs. Lockwood have one in the press. You will find articles in back volumes. and in the cyclopædias; but the trade is much of a secret in all important details.)—T. W. K. (If you cannot find one in all those volumes, we should advise you to look at some of those sold by the seedsmen.)—Ironmonger. (See indices of recent volumes, and the articles now appearing. No machine yet invented does more work than is put into it. How could it?)—Snowdrop. (Your query is incomprehensible.)—F. W. B. (If the facts are as you state, you are a tenant from year to year, and your landlady must give you six months' notice, terminating at the time at which you took the house, before she can raise your rent or turn you out. If you have failed to keep the premises in proper repair, she must take other steps; she cannot summarily raise the rent in the manner you mention.)—W. A. (Illegitimacy does not in any way affect a man's capacity to make a will.)—W. S. (We really cannot understand the query, and you had better consult a solicitor. Most probably the son and grandson will share equally.)—Boz. (You can recover if the accident was caused by the butcher's negligence or that of his servants.)—Spec. (If the "company" is not limited, an ordinary partnership agreement would suffice. We cannot advise further.)—Cymro. (Slates cannot be tested in the way you suppose. Judgment and experience are necessary in estimating durability.)—F. G. (In type.)

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 2, 1883.

A FEW HINTS ON CARPENTRY.—II.

IN the last brief paper I promised to give directions for putting shelves together without nails, which do not make either the best or strongest joint. If they *are* used, it is better to insert them alternately to right and left, so that they shall not follow exactly the direction of the grain where they go into the ends of the shelves. Wire nails driven straight down into the end of a deal board have not much hold, although I am aware that some think them better than ordinary wrought-iron nails, because the latter are wedge-shaped, and, therefore, if drawn out a little way become (so it is argued) loose from end to end. But in reality, the angle of the wedge is very small, and the nails only taper in one direction, two of their sides being parallel, and the roughness of the iron acts like a set of teeth in giving them holding power, while the wire nails are smooth. The heads of wire nails, too, are not easily driven below the surface, while a clasp nail may be readily imbedded, and itself acts as an additional holdfast. Screws, again, are no use in the end of a deal board; they will draw straight out, bringing with them the fibres immediately surrounding them, and leaving a cylindrical hole. By far the neatest plan for oak shelves is the wedge driven through the tenon and left outside, and it has this additional advantage, that it can be knocked out, leaving the shelves and sides as plain flat boards, which can be readily packed for removal if required. Deal shelves can also be thus made if sufficient length of tenon is left to prevent the wedge from splitting out the stuff; but there is no sort of comparison between deal and oak, though the former be painted, or grained, or varnished; and though the cost of the stuff is a little higher, I would always recommend oak, and oak alone, for study shelves and fittings. But oak is a generic name of a certain kind of tree, and for home operations especially the ordinary English oak is most untractable. Stave oak is the stuff, such as barrels are made of. I believe it is of American growth; at any rate, it is straight grained, easily planed, and pleasant to work. I had, lying about, some blackened old cask staves doomed to be burned; but the other day, wanting a bit of oak for another purpose, I made use of a piece of this waste material, and it was so dry and so pleasant to work that I hunted up some more out of the wood pile, and made a bracket for the hall out of it, and very satisfactory it proved. I give a sketch, as it is rather a nice pattern, and will hold a small flowerpot. The shelf with chamfered edge is a bit of the top of the cask. The size was limited, as the cask was small, and the staves therefore much curved; but staves from any large cask will afford several fair-sized bits of stuff that will allow of being planed flat. Indeed, I have of late laid hands upon all such staves and cask heads, which I plane up and keep in the shape of small square boards ready for any such odd jobs. But I must return to the shelves. The double tenon is the best if the shelf is over 6in. in width. It is represented in Fig. 2, and of course a single tenon is wedged in the same way; but if there are three or four shelves, only the top and bottom ones need be so made, the others being slid into grooves or made with quite short tenons that will not come through the sides. The removal of two or four wedges from these shelves on each side will thus free the whole, and reduce them to flat boards, ready for packing. A great deal of oak furniture might be thus made, and very convenient it would prove. If wedging is objected to, a very good plan is to pin the tenons through edgeways with either hard wood or metal pins, each tenon having its own, as *ab* of Fig. 4; or with one long metal pin right through, if the width is not too great. The front of the hole can be countersunk, and a turned knob made to hide the pin, like B, which is partly in section to show the cup-like form; the head of the pin projecting into the hollow, so that when the knob is removed it can be got at and pulled out. Unless for the sake of portability, glued tenons will hold if well fitted, and need not project or be visible; but if shelves are to hold much weight, one here and there ought, at any rate, to be more strongly secured. Given a supply of nice clean oak stuff, and skill to use a saw and plane, there is nothing to hinder an amateur from fitting up to a great extent his own study. Even the Glastonbury chairs are very simple; and are wedged up on the same principle as the shelves; and an oak table with crossed trestle legs always looks well. When curved stuff is needed, a sweep saw must be used, but there is no difficulty in using it unless it be that the blade must be kept always truly perpendicular to the flat face of the board. A finely-set spokeshave, or plane with curved sole, or one of the American ones with a sole made of thin steel, which can be made to take any desired curve at pleasure, will be all that is needed to follow the saw, with perhaps a rasp and file to finish.

Fig. 1.

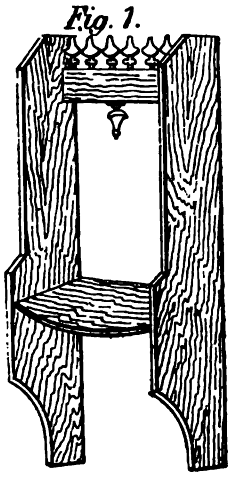


Fig. 2.

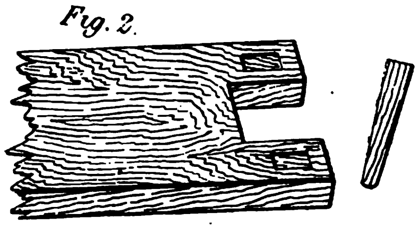


Fig. 3.

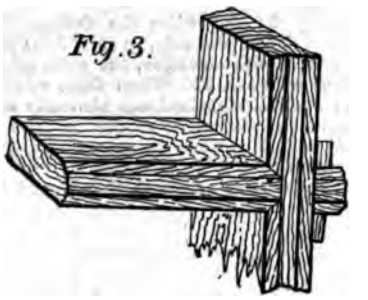
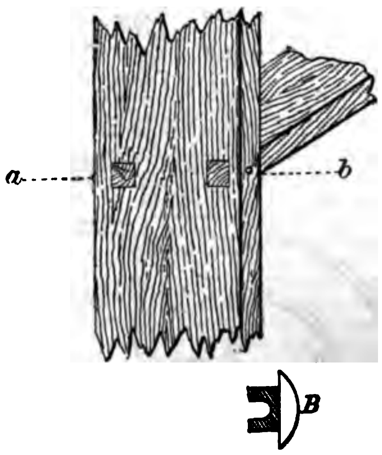


Fig. 4.



What I mean by trestle legs is shown in Fig. 5. They are cut out with a turn saw of oak board 1in. thick. A hole bored in the centre of each takes the tenon B of a long bar, round or flat; but the tenon is to be rounded and slotted for the wooden wedge that secures the parts. There are various patterns used; but the plain double curve shown is as good as any. The tenons above are mortised into a pair of flat rails, which take the table top. The latter is attached by screws put in from below, and which do not appear on the surface. If the tenons are pinned, this table may be taken apart in a few minutes; but it is very stiff and strong. There are many quaint designs of oak furniture which can be carried out in equally simple manner, besides those usually called ecclesiastical — strong substantial articles which would repay an amateur's trouble a great deal better than the usual ones that are given birth to in the home workshop. As regards the appearance of all work of this class, due care
not to make it heavy and
hand, nor mean and
bit of board 1in.
heavy if it is
half that wid
table le
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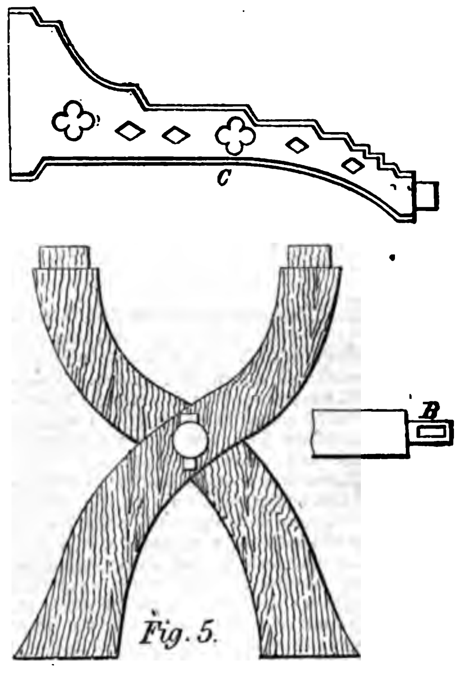


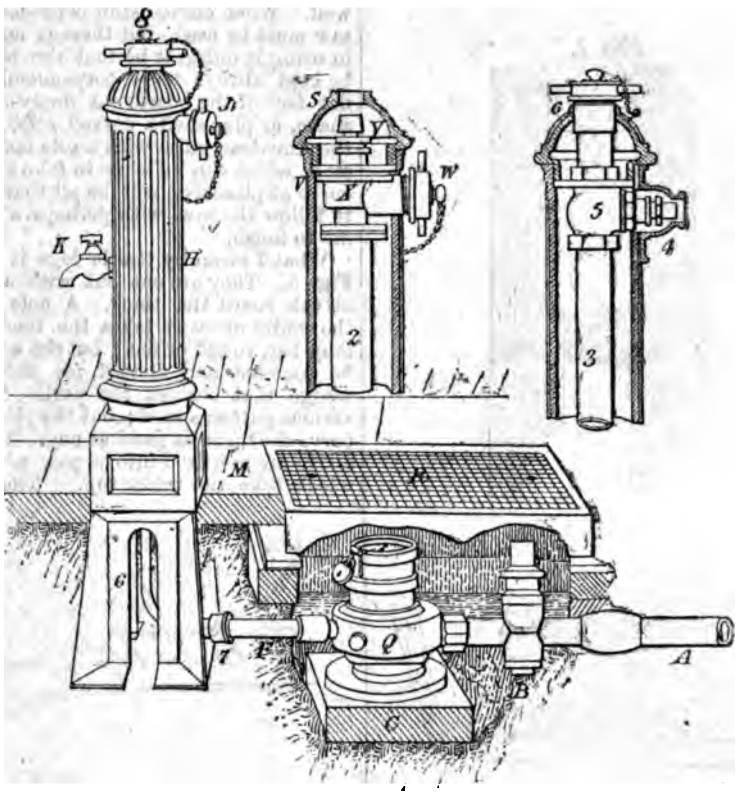
Fig. 5.

PRACTICAL NOTES ON PLUMBING.— LXXXIII.*

By P. J. Davies, H.M.A.S.P., &c.

Water-Cart Hydrants.

THIS hydrant is shown fixed at H J K, Fig. 393. Here the pipes from off the meter are usually of iron, and at times a meter is fixed as shown at Q. There are various kinds of meters, but the one generally in use is that working upon the principle of reaction (as in Barker's mill), a section of which is shown at Fig. 394. This is a drawing of a meter made by Guest and Chrimes, and one which, some 18 years ago, I fixed at Brixton, Peckham Rye, and Queen's-road railway stations (and many other places). It has worked well ever since, and I shall have occasion to speak of this meter hereafter. In Fig. 393, at Q, may be seen one of J. Tyler and Sons' meters. They are excellent water measurers, and good enough for all practical purposes, and are becoming well known. In front of the meter, as at B, is fixed a stopcock; and in a tube between the stopcock and meter is fixed a strainer, for which see the section of Guest and Chrimes's meter at 2 B and 6, Fig. 394. At A, Fig. 393, is the joint connecting the lead pipe to the stopcock. I have here shown a plug stopcock, because I fixed this class of stopcock at the before-named railway stations, and which for this purpose stands well, though now the screw-down kind is generally enforced. When fixing these meters as shown carefully protect them from the frost. Cover the dial with a plug of hair felt, in shape something like an ordinary pen wiper; and at F, or where most practicable, fix an emptying cock to empty the pipes. H I J, Fig. 393, is the before-mentioned hydrant, and which we will now call a street standpost; the water is supplied by meter or otherwise. When the water is on constant, the shut-off valve, to supply the water to the standpipe, may be fixed as shown at the section 5 and 4, Fig. 393, which in this case allows the standpipe to be screwed on the firehose cap 6; but when the firehose is required to come off the side, as at W J, as shown in the section and elevation, the valve is generally fixed as at X Y. When these valves are fixed as shown, the standpost generally stands charged for the purpose of supplying pails, &c., as at the cock K; hence one reason why we call it a standpost.



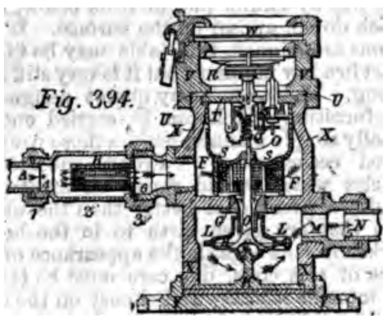


Fig. 394.

When such cocks are fixed, they should be of the class known as waste-preventing cocks, a section of which is shown at Fig. 394 A.

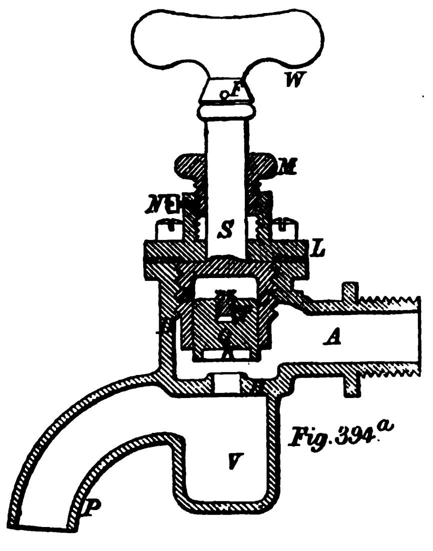


Fig. 394^a

This is known as Tyler's waste, not cock, the action of which will be readily understood from the following: It is worked upon the same principle as the valve described at Figs. 151 A, 161, and also at Fig. 185.

A, Fig. 394, is the outlet, B the valve seating, K the rubber valve, Q the falling plug which is actuated by the close-fitting socket or
C, the outer sides of which are screwed
coarse thread, or a double thread, as t
lift will be quicker, or double that of
one whose threads are of the same size.
lathe mandrel screw tool will answer
purpose, and if the brass finisher is wel
his work, he can strike double threads at

The falling plug, Q, should be made
as possible, in order that the plug may f
than it otherwise would do. All the oth
of the cock are much about the same a
ordinary Rotherham or Brighton patter
down cock, shown at Figs. 390 and 386,
examining this cock closely, and comp
with the Rotherham, and especially the
stopcock, or the cock Fig. 133, it may
that the same principle may be observed
the Rotherham and Brighton stopcock
waterways are reversed. The end of the
spindle is drilled and made cup-shaped t
the end of the loose valve or jumper.
pose the spindle of the jumper to be la
½in. to ¾in. diameter, and the same ma
accurately into the end of the actuating
and the cock put on the wrong way abo
by turning up the spindle the valve
drawn up with it, and so, in due time, and
ing to the fit, the valve will fall back
seatings; and who can say that this wa
the original idea concerning this class o
preventing cock.

Let us turn to Fig. 395. This diaphrag
preventing cock is made by the well-kn

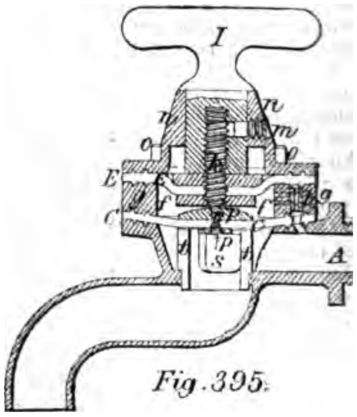


Fig. 395.

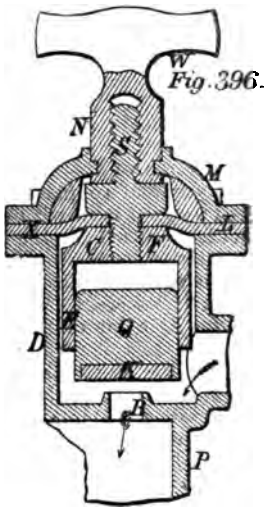


Fig. 396.

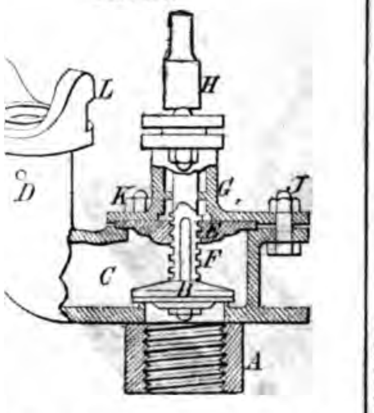
of Lambert and Sons, and the valve is
upon by the same principle, namel y, su
that at Fig. 394. This valvo, Fig 395,
simply of two diaphragms as shown at
Fig. 395, and is, as in Fig 394, actua
spindle L, with a screw K, which allow
diaphragm to be raised or depressed, and
by reason of such motion, causes the
diaphragm C with its valve to foll ow. Su
top diaphragm to be depressed, the bottom
be forced in front by reason of the space
the two diaphragms being filled with wa
the same reason, when the top diaph
raised, the bottom diaphragm must fol

---

* From the *Building News*. All rights reserved.

g the aperture over the seating T is d the water allowed to run during the his diaphragm remains off the seating, not be long, because there is a small ; *h*, which allows the water to pass 1 below to above the bottom diaphragm versa; that is to say, when the top . is depressed, and the lower diaphragm water will be forced back through the rture *h*. Sometimes the falling plug worked in conjunction with the dia- modification of which is shown at Q (Figs. 396, 149, &c.). Sometimes valve is formed on the diaphragm, and ade to actuate the diaphragm, whilst mes the diaphragm is made to actuate plug, &c. At Fig. 397 is a section of

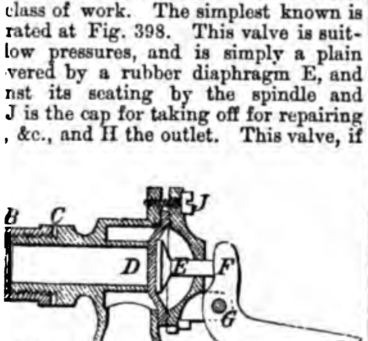
FIG. 397.



drant, showing the valve to be of the e kind (as in the Rotherham cock, the being the plate E), and round the stuffing-box with glands. Q holds the standpipe, and fastens it to the valve- er the method of the bayonet-point, of the best and quickest methods of upling.

Ball Valves.

he fittings connected with plambing, one of so much importance as the of an efficient and good ball valve. ld receive the most careful attention of er, for a ball valve suitable for one ill be for another utterly useless. I fore, show and describe a few suitable class of work. The simplest known is rated at Fig. 398. This valve is suit- low pressures, and is simply a plain vered by a rubber diaphragm E, and nst its seating by the spindle and J is the cap for taking off for repairing , &c., and H the outlet. This valve, if



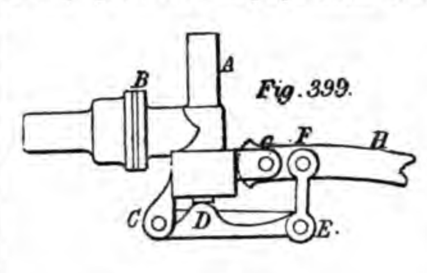
398.

g is reduced to a small bore, say ⅛in., is ly good for feed cisterns to boilers. e has been made to an endless number it patterns, and to various shapes, many have been patented, but are not so good ginal pattern, Fig. 398.

fixing the ball valves, see that there are avings or dirt under the seating before it, as such will cause the valves to let ter. By closely examining this valve 400) the principles of the safety valve een, and it will act as such when fixed wn.

ound Lever Pattern Ball Valve.

99 is an elevation of one of these ball d Fig. 400 a section. It will be seen simply a disc and L a valve, which is its seating by the short lever D, and which, by the pin E and connecting link U, is connected to the long lever at F; G is the pin or fulcrum of the long lever H; M is the spindle for keeping the valve L perpendicular to the



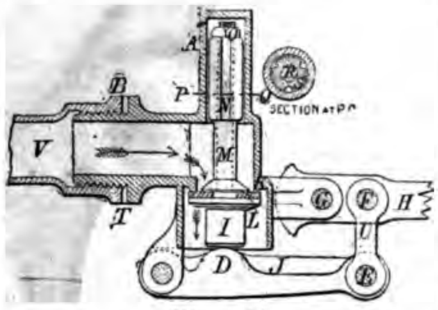


Fig. 400.

base of the seating; and N the feathered guides working middling tight within the cylinder A P. R S is a plan of the same.

The action is as follows:—The water enters at V, passes on and through the seating; but when the valve is closed as shown, the water is upheld according to the power put upon the ball and levers H D.

CAUTION.—When fixing or examining this valve, do not pull up the ball with much force, or you will strain the bottom lever or cut the valve rubber, and so render the valve useless.

This valve is a nuisance when the water is constantly on, as it is of all valves the longest shutting off, the long lever having further to travel in proportion to the closing of the valve than the lever of any other ball valve.

(*To be ontinued.*)

ENGERT'S IMPROVED STEAM BOILER.

AN improved steam boiler, designed by Mr. A. C. Engert, and constructed by Fraser and Fraser, of Bromley-by-Bow, has been at work in the factory of the designer at Three Mills-lane for over 10 months, with advantages which we shall proceed to describe. The boiler in question consists of a cylindrical shell, 7ft. in diameter by 16ft. 6in. long; but instead of having two circular flues, as is usual with Lancashire boilers of those dimensions, it has only one furnace flue and a return of the following dimensions. The upper, the front portion of which contains the furnace, is 4ft. 8in. wide and 10in. high; the "flat" construction demanding stays which are supplied in the shape of a number of 3½in. water tubes placed 9in. apart. The under or return tube is similarly constructed, but is only 4ft. 6in. wide; and there are two flat ends secured to the shell in the usual manner. The front portion of the upper tube is spread out into a sort of flattened bell-shape to form a furnace which is strengthened by rings about 12in. apart. The fire bars slope towards the front, and are turned up 3½in. to prevent the fire from sliding off into the box in which is placed the door. The fire itself is shielded by one of Engert's curtains or shutters, which prevents draughts of cold air from rushing over the top of the coal. This curtain is [illegible] to the damper that when th[illegible]

is closed. There [illegible]

the grate, and n[illegible]

down the bott[illegible]

fall through th[illegible]

ever, the inve[illegible]

jet impingi[illegible]

to assist [illegible]

tion of [illegible]

arrang[illegible]

known, and that although the boiler is fed by water from the Lea it never scales, and is perfectly cleansed by simply washing and brushing out. This latter result is partly due to an arrangement for heating the feed. In what may be still called the flue chamber a tank 4ft. 8in. wide, shaped so as to occupy the full length at the upper part of the boiler, but curved where the top flue enters and the gases sweep round and down to enter the lower flue, is placed, open to the atmosphere, and supplied with water by a cistern. This water is heated by the flue gases, and also by steam passing through a pipe, whence it flows towards the furnace and supplies the small jet above mentiond. By this arrangement the impurities of the feed are thrown down to the bottom of the tank, whence they are removed by a blow-off tap daily. Mr. Engert's object, however, is not only the removal of the lime, &c., but also the gases contained in the water, as he holds that the violence of explosions is considerably increased when a mixture of steam and gases has collected in a boiler. Without subscribing to that opinion, most steam users will agree that the plan of depositing "scale" outside the boiler is decidedly an improvement. The passage of the furnace gases through the flattened flues, impinging as they do against the vertical water tubes, creates a rapid circulation of the water, and the result is seen in the test trials which have been made, which give 11·3lb. of water evaporated from 82° Fahr. per pound of coal, the area of the grate being only 13 square feet. That is equivalent to 13lb. from and at 212° Fahr. The firing was done at intervals of about 25 minutes; nearly half a hundredweight of coal being thrown into the furnace at each feed without producing more than a slight colour in the gases escaping from the top of the chimney. Such results as these are obviously worth the attention of steam users, who, we believe, can see the boiler at work any Tuesday or Wednesday, at Mr. Engert's Works, Three Mills-lane, near Bromley Station, Tilbury and Southend line.

THE DYNAMO: HOW MADE AND HOW USED.—VII.*

By SELIMO R. BOTTONE.

Currents given by these Machines not continuous.

§ 15. SINCE the direction of the current changes at every semirevolution of the armature in such machines as those of Clarke, Pixii, and Siemens, and at every passage of the compound armature before the poles of the inducing magnets in Soren Hjorth's machine, we are constrained to use a commutator whenever we desire to produce a current in one direction only. But the commutator, by the very fact of its being necessarily constructed of two or more portions of a metallic cylinder, separated by intervals of insulating material, interrupts the passage of the electricity every time that the springs press against the insulating spaces. Hence the electricity furnished by these machines partakes more of the nature of rapidly succeeding waves, than of a steady continuous current, like that furnished by the battery. Still, when the armature is rotated at a high speed (and the Siemens requires to be driven at about 3,000 revolutions per minute, to give the best effects), these waves succeed each other with such rapidity as to simulate a steady current, no break in continuity being perceptible to ordinary tests.

Rapid Magnetisation and Demagnetisation produces Heat.

§ 16. It is found that the sudden change from north magnetism to south magnetism, which takes place in each half of the above described armatures, as they pass over from before a south pole to before a north pole of the inducing magnets, is accompanied by a very considerable rise in temperature; and that this rise increases with the rapidity of change of magnetism, which in its turn depends on the rapidity of rotation. So [illegible]ed is this rise of temperature, that a dynamo with a Siemens armature of the pattern [illegible] 14, and started at an initial tem- [illegible] rises in about twenty minutes [illegible] driven at 3,000 revolu- [illegible]ise in temperature is [illegible] of the machine.—

1st. Because the wires of the armature, becoming heated, conduct less freely; hence loss of current. 2nd. Because the armature itself is not capable of such intense magnetisation when hot as when cold (a red-hot mass of iron is hardly affected by the magnet); hence another loss of current. 3rd. Because the insulating covering of the wire is impaired, even if not actually ruined, if the temperature exceeds a very moderate limit.

For these reasons it is important to keep the temperature of the armature as low as possible. The first successful step in this direction was taken by Dr. Pacinotti, of Florence, in 1860, who constructed an armature of soft iron, in the shape of a ring, around which were coiled, in successive sections, helices of insulated copper wire, the ends of which were joined up to a divided ring commutator. The ring armature of soft iron, with its covering of wire, was supported on a central axle, and rotated before the poles of a magnet, either permanent or electro. At no part of the revolution is such a ring taken as a whole farther from, or nearer to, the poles of the magnet; and although its magnetism is constantly changing, yet the change is not abrupt, but gradual and continuous; as will be explained in the following paragraph.

Pacinotti's Ring Armature.

§ 17. The description and illustration of this machine is to be found in the *Nuovo Cimento* for the year 1864, under the heading of "Una Descrizione d'una Piccola Macchina Elettro-Magnetica." The machine itself, as described, can be used either as a motor, or as a generator of electricity; and its adaptability to either purpose was specially dwelt upon by Dr. A. Pacinotti, in his communication; but it is only under the aspect of a generator that we shall stop to consider it here.

Two electro-magnets S, N, Fig. 13 (which may, or may not, be united together below), are fastened to a base-board, and so arranged that the upper extremity of one is a north pole, while the other is a south pole. These poles are furnished with semicircular prolongations B B, B′ B′, between which is poised, on the axis C D, a soft iron ring A A. This ring is attached to the axis by means of radial arms. Coils of insulated wire are wrapped round the ring at short intervals about its periphery, the end of each coil being brought down the axis at D and attached to one of the small copper strips at E (of which there are as many as there are coils around the ring), the wire beginning the next coil being also metallically connected to this same strip. The wire terminating the next coil is fastened to the next strip, from whence starts a fresh coil, and so on, until all the strips, which form the compound commutator E are connected to the coils in such a manner that the end of one coil, by its attachment to its strip, forms the commencement of the next. Consequently, the wire forming the coils, although capable of communicating electrically with the springs F F at opposite points of the diameter of the commutator, is really continuous. The ring A A is caused to rotate by means of the rigger G and the driving belt H.

It will be evident on reflection that the half of ring opposite the pole marked N will acquire by induction *south magnetism*, while the half facing the pole S will for a similar reason become *north*. Hence the ring, whether in motion or at rest, will, provided the electro-magnets be active, become a circular magnet, with the S. pole facing the N. pole of the electro-magnet, and its N. pole facing the S. pole of the electro. When the ring is rotated, though if viewed as a whole, this magnetic condition remains unaltered, yet, of course, any given portion of the ring will gradually change as it passes over from one "horn" or prolongation of the magnets to the other. Still, the change which takes place is not abrupt, but gradual, and partakes more of the nature of a *wave* than of *shock*. So also, since the springs of the commutator press on several strips at the same time, at no time is contact ever entirely broken between the commutator and the springs; therefore the current which is produced as a continuous wave, *always in one direction*, is collected in a similar continuous manner by the springs F F, and may be employed where required by coupling up the wires I I.

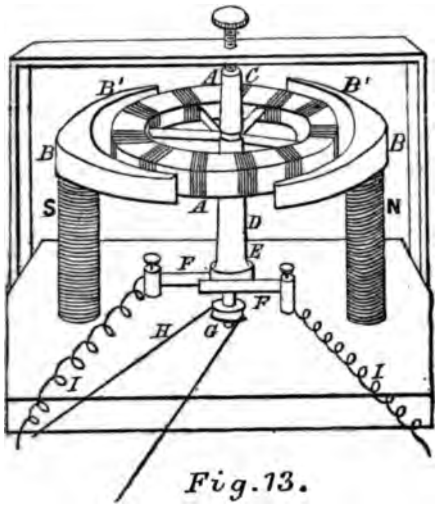


Fig. 13.

This machine, discovered more than 20 years ago, embodies all the essential characteristics of the best modern machines, and the much-vaunted machines of Gramme, Brush, Siemens-Alteneck, Maxim, Edison, &c., &c., are, at best, but trifling modifications of the Pacinotti ring machine—modifications which have not always been improvements. Having now brought our brief sketch of the essentials of a dynamo to a close, we shall proceed in our next section to constructive details.

Ten years ago iron rails were manufactured by all rail makers, and steel rails by comparatively few; the latter now form 95 per cent. of the total output.

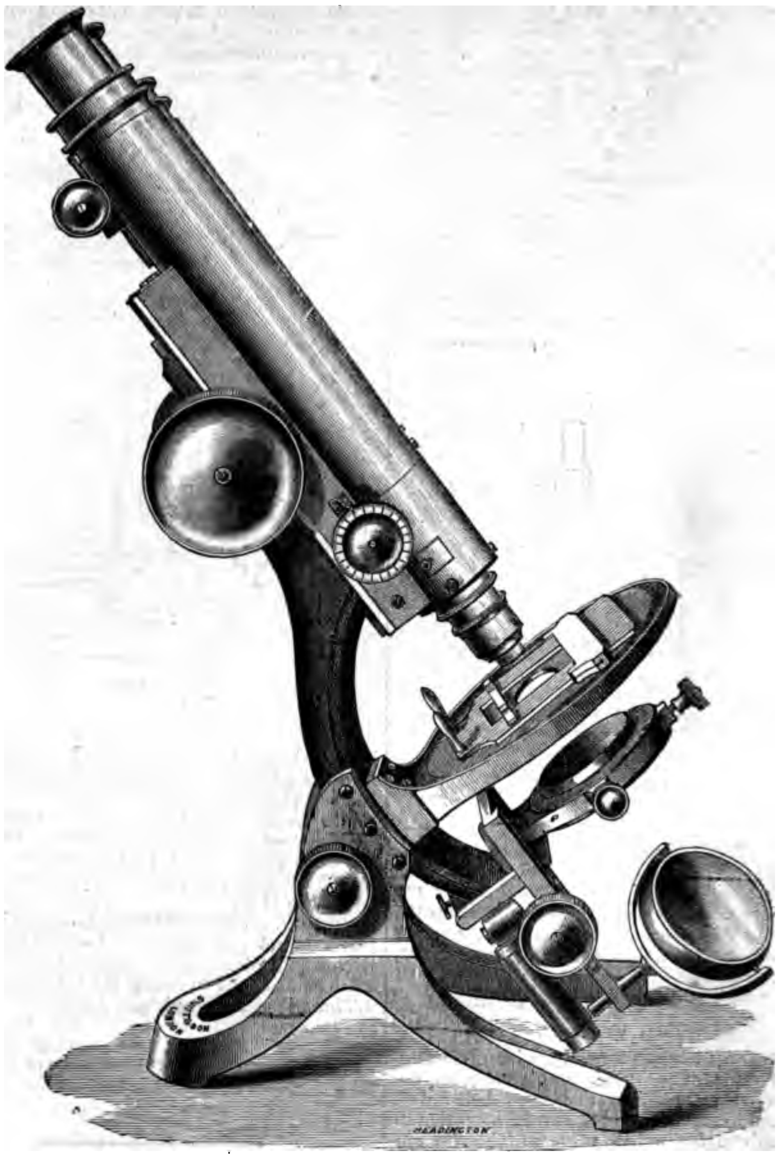


Fig. 1.

SWIFT AND SON'S RADIAI INCLINING MICROSCOPE.*

FIGS. 1 and 2 show a new microscope, m
by Messrs. Swift and Son, which is an
provement of Wale's working microscope.
improvement consists essentially in making
movement of inclination radial with the ob
on the stage, so that a beam of light from a fi
source directed upon the object remains o
during any inclination given to the microsc
Thus suppose the light from the mirror tc
directed as in Fig. 2, then, if the limb is incli
to the horizontal, the light will still be upon
object, the incidence being, however, greatly
creased in obliquity.

This result is obtained by making a sec
groove on either side of the limb radial with
object on the stage. The top of the tripo
provided with jaw pieces fitting in the sec
grooves, and a clamp screw causes them to
the limb at any position of inclination.

The under face of the stage is flat, so a
present the least obstacle to oblique illuminat
and the required strength in the attachmen
the limb is obtained by thickening the rim or
upper edge as it approaches the limb, as dev
by Mr. Tolles. Friction stage movements c
the object. The sub-stage fits on the lower
of the limb by a dovetail slide, which appear
be a convenient arrangement for rapidly att
ing or removing it. The mirror can be use
shown in Fig. 2, or on the tail-piece, as in
1. A telescope rod carries a bullseye lens
prism, with ball-and-socket joints, as show
Fig. 2. The fine adjustment is on the sy
applied to Messrs. Swift's previous model.
The new microscope is extremely steady is

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* Journal of the Royal Microscopical Society.

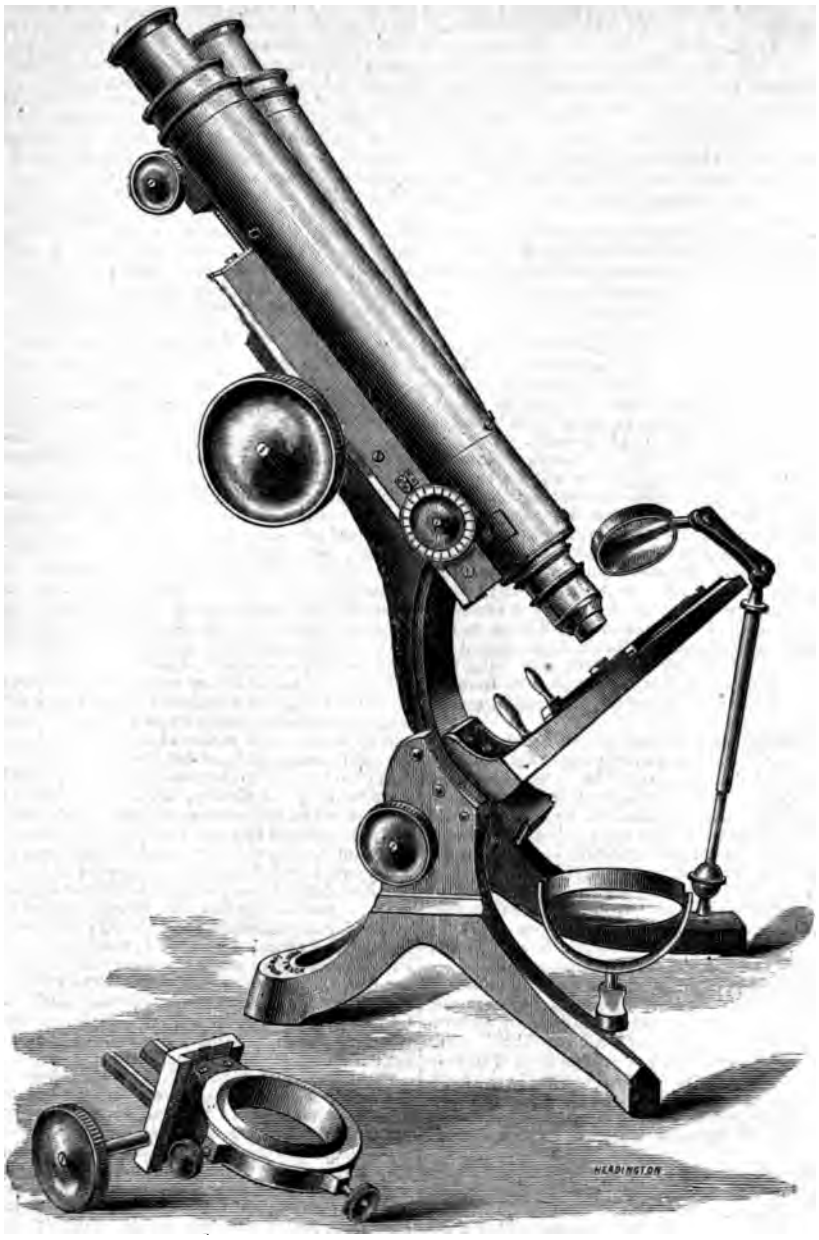

Fig. 2.

positions of inclination, in this feature meriting the favourable opinion of Wale's original model expressed by Dr. Carpenter.

COMETS.

UNDER this title, Mr. E. B. Knobel, Secretary of the Royal Astronomical Society, delivered an address at the Royal Victoria Coffee Hall, Waterloo-road, S.E., on Tuesday week. It formed the fourth of the series of Penny Science Lectures now being delivered in that building under the auspices of the Gilchrist Trustees, and, like the earlier ones—which have been reported in the last three issues of this journal—was illustrated by a series of views shown by the oxy-hydrogen light. The theatre was well filled, the address was attentively followed, and at the close the lecturer was called before the curtain. Having alluded to the fascinating nature of the appearance of comets, and to the interest they have awakened in the minds of all observers from the earliest periods, Mr. Knobel described some of the larger and more interesting comets that have been noted, showing illustrations of each upon the screen. The comet of 1264 was one of great brilliancy and excited great attention; it was now lost to our system. In 1680 a comet appeared which was rema
not only for its great splendour, but becau
its movements Edmund Halley, or
labourer, calculated its orbit and predic
of its return. The science of mathema
comparatively in its infancy, the w
tions had to be performed without t
can obtain, and were in themselv
intricate that the minds of most m
from undertaking so gigantic a

persevered, however, and ultimately ascertained the orbits of some 24 comets; this of 1680 he believed to have a period of 575 years. Two years afterwards, in August, 1682, another comet appeared, which Halley found agreed so exactly in position with one which Kepler had observed in 1607 that he believed it must be the same; and he was confirmed in this opinion by the fact that a similar comet had appeared in 1531. He calculated its orbit, and predicted that it would return at a period between 75 and 76 years. Its return would be, he considered, somewhat delayed by its proximity to the great planets Jupiter and Saturn, but he believed it would be completed in the winter of 1758, and left on record an instruction to astronomers to keep a look out for it in that year, and should it re-appear to recollect that it was an Englishman who foretold its period of return. As the time for the reappearance approached, two French astronomers, Clairaut and Lalande, resolved to test the prediction, and to ascertain the exact period at which the comet, now known as Halley's, might be expected. The arithmetical calculations were undertaken by Lalande, who was assisted by a French lady, Madame Lepaute, and they continued at the laborious work for six months, sometimes
not
They came to the
ld be retarded
r and
for,

was ascertained with such exactitude, although it could be followed by human eyes during an exceedingly small portion of its journey, that its reappearance in August, 1835, was predicted within our days of time and one degree of space of its actual place and period. It will not reappear until the year 1911. In 1836 another comet was seen, of which illustrations were shown; the coma was a nebulous mass like a Medusa's head, and the whole was very indistinct. In 1743 a comet was seen and named after Cheseaux, which had six tails of nearly equal length and brightness. Mr. Knobel added that he had a few days since examined the original drawings and notes made at the time of its appearance, and could, therefore, testify to the correctness of the extraordinary-looking illustration; while quite recently some entirely independent observations made in a Russian observatory at the time had been published, and confirmed those previously made known. The lecturer also showed illustrations of the great comets of 1811 and 1843; the former had a very long tail, and the latter was remarkable from being visible by daylight, and from having approached nearer to the sun than any other known comet; as the wine crop of that year was exceptionally good, it received, as most persons could remember, the name of the "comet wine." Incidentally the lecturer mentioned at this point that the tails of comets were continually changing in appearance, and seemed to be no more an appendage to the loose nucleus than was the smoke of a steamer a portion of the vessel. The analogy was very complete, for the tail was continually streaming away into space, and that seen one night was by no means the same as that seen another. Very many comets showed a dark space in the centre of the tail, beginning a little below the head. Most of the elder members of his audience would remember the magnificent appearance presented by Donati's comet, the next of which he had illustrations, during the autumn of 1858. Not only was the tail extremely long and brilliant, and of a feather-like form, but there were curious faint rays noticed on the upper side, and Professor Bond, of Harvard University Observatory, noticed also a singular pulsation in the tail, which was afterwards recognised by others. This pulsating movement of the light had been seen in earlier times, and was easily detected in the comet of 1876. This very beautiful comet of Donati would never again be seen by any of his audience, for its period of revolution was reckoned at about 2,000 years. Recurring to Halley's comet, he might mention that it had been calculated that this was the one recorded to have been seen soon after the death of William the Conqueror, and that it also appeared about twelve years before the birth of Christ, and although it had not been seen since 1835, we knew its exact position in its ellipse at the present time, and almost precisely the date at which it would reappear. No doubt his audience would like to know how we were able to calculate the movements of a star only seen for so extremely minute a proportion of its circuit. The calculations were too complex to explain in so short a lecture, but it depended on observations of the velocity at which a comet moved towards or from the sun, during the time that it was about the same distance from that luminary as the earth; if this rate of velocity was less than 26 miles a second while at this part of its orbit it must be brought back by the sun's attraction at some future period, the time being shorter in proportion to the slowness of the movement, and we, or our descendants, would again see it. If the velocity exceeded 26 miles a second, the comet would go off into infinite space, and was certainly not a member of our system. Later in the evening, the lecturer exhibited photographs of the telescopic comet seen that day year, from negatives taken at the Cape of Good Hope by Mr. David Gill, the Government astronomer, and mentioned that these photographs often revealed details as to a celestial object more clearly than could be observed by the astronomer, while they afforded a faithful record for future reference. This comet had but a slow motion, and a period of revolution round the sun of about 600 years. On the night of 30th July, 1861, everyone was attracted by the sight of a great comet, which then attained its greatest brilliance, in the north-western sky, illustrations of which the lecturer showed. This comet came so near to the earth that astronomers believed we must on that day have passed completely through its tail. Many independent observers reported that the atmosphere and sky on that night had a peculiarly luminous appearance, and some considered that it exhibited a phosphorescent appearance. Another noteworthy comet was that known as Biela's, which was observed in February, 1826, by an Austrian officer of that name stationed in Bohemia. The path was seen to be
ntical with comets which had been seen several
before, notably in 1772 and 1806, and it was
termined that this comet made a revolution
in about six years and eight months.
redicted, in 1832; but was in an
tion in 1838, and so escaped ob-
ppearance in December, 1845,
, not one, but two,

distinct comets occupied its place, moving in distinct and independent orbits in close proximity, and sometimes one and then the other was the brighter till they finally disappeared in the following April, 1846. In 1852, these two parts were further separated, and since that time it has never been seen, although on one occasion, in 1872, we passed near its right path. Where had it gone? Most of his hearers would remember that in August, and again about the end of November, the earth crosses the path occupied by great numbers of meteorites or "shooting stars," and that on these nights, especially about the 27th to 30th November, showers of these shooting stars were visible. They were found to have stated periods of special brilliancy, and always to radiate from definite points in the heavens, and these facts set men thinking as to their cause and character, and as to whether they had any connection with comets. In 1872, when we ought, as he had just stated, to have seen Biela's comet, or comets, in September, it had disappeared, but on November 27th we passed through a dense shower of these meteoric stars, and these occupied the exact position where the comet should have been observed at that period. These were not apparent in Europe, but, suspecting that such a shower would be seen, a German astronomer telegraphed to Mr. Pogson, at the Madras Observatory, to look on the track of the lost comet, and see if any fragments, as it were, in the form of meteors, were visible, and, as he had just stated, they were found as expected. There could be no doubt that these represented the lost comet of Biela. Meteors, it was evident from frequent observations, were very small bodies travelling round the sun in dense swarms, in orbits which brought them at certain times comparatively close to our earth. They could only be seen when they came very near indeed to us, and their brightness was the result of their having to encounter the resistance of the earth's atmosphere, and so being rendered white hot, and ultimately burnt up. They then fell upon the earth, as dust or stones, and a fine collection of these meteoric stones could be seen at the British Museum. By means of the spectroscope, it was now easy to analyse the component parts of any light, the lines and bright spaces in the ray on the spectrum divided by the prism being an absolute test. Dr. Huggins succeeded in examining the faint light of a comet by this means, and found that the spectrum was marked by the same dark lines and bright spaces as the light from the blue portion of a gas flame or common candle, and on breaking up and burning meteoric stones similar results were arrived at. The theatre of the Royal Institute was illuminated one evening in 1881 by gas produced from such stones, when it was evident that the light from comets, from meteors, and from coal-gas were almost identical. The lecturer showed copies of spectra observed from a recent comet and from gas in illustration of this point. From all these accumulated facts it was believed that comets were made up of aggregations of meteors, for (1) not only did they move in the same paths, but (2) dense masses of meteors were found in 1872 in a space previously occupied by a comet, and (3) the composition of the light of comets exactly agreed with that of meteors, and with those which had fallen as stones to the earth. But only a few comets belonged to our system; some of the most splendid apparitions that had illuminated the heavens moved in infinite space unfettered and untrammelled.

THE TRANSMISSION OF ENERGY.
II.*

By Prof. Osborne Reynolds, M.A., F.R.S.

In my last lecture I dealt with the transmission of energy through the means of coal and corn, showing that by either of these means power may be transmitted by rail, with an expenditure of 1-12,000th per mile, or by water of 1-120,000th per mile, this either through the agency of horse or steam. This ease of transmission, however, depends entirely on the railroad or water, and is only possible between places so connected. Hence such means are only applicable to what may be called the mains of power.

We come to-day to consider other means of transmitting energy in smaller quantities applicable to its distribution for immediate application. Such transmission is not a matter of secondary importance, although the distances over which it is transmitted may be comparatively insignificant.

Now the means of artificially transmitting power may be considered as three. The power may be stored in matter in various ways, and the matter with the energy transported—as, for instance, in our watch springs. The second means is the transmission of power by moving matter, without actually storing the power in the matter—as in shafts and belts, hydraulic connection, &c. And the third method, which is distinct from the others, is the transmission of energy, in the form of heat or electricity, by the flow of currents through conductors; in this way all the power in the steam passes through the boiler-plates from the furnace into the boiler. Of course, each one of these means includes an infinite variety of detailed contrivances, more or less dissimilar. But there is good reason for classing them under these three heads, for all the contrivances under each of these heads are subject to the same general limits, whether those of efficiency or distance.

There is one thing in common to all these means of transmission, and that is that they all involve a material medium. The quantity of matter required constitutes a primary consideration in all of them. This quantity of matter is fixed by what we may call the properties of matter, one of the most important of which, as regards the first two means, is the possible strength of material. Looking round, we see the effect of the limited strength of material in all nature's works. Of course it may be that we shall be able to work with stronger materials than we have at present. Organic materials, such as the feathers and tissues of animals, are stronger than steel, weight for weight, so that there is a possibility of improvement; but that man will go beyond nature in constructing organic fibre seems improbable, and such possibility of improvement as exists may be discounted. At present we may set down our strongest working material as steel, the art of working in which is so perfect that we may calculate on nearly the greatest strength for all purposes. I have taken fifteen tons on the square inch as the limit of safe working tension, in making the estimates which I shall now bring before you. First of all, I will ask your attention to the possibilities of transporting power in a stored form.

The question of economy in the conveyance of energy in a stored form is simply one of the intensity with which it can be stored. If we want to carry energy about, we must have it stored in some material form—and this material has to be carried by ordinary means—so that the question of economy is simply the amount of available energy that we can store in a given amount of material.

If energy, stored in a particular manner, is more readily available for some special purpose than that stored in another, then it may, on the whole, be more economical to carry it in that form. This is abundantly illustrated in our watch springs.

The greatest amount of energy that can be stored in a given weight of steel is very small, compared with other means. To take a familiar unit, to store the energy necessary to maintain one-horse power for one hour would require no less than fifty tons of steel—that is to say, fifty tons of steel in the form of watch springs, all fresh wound up, would not supply one horse-power for one hour; and yet this is the commonest form in which energy is carried about.

It is the adaptability of the spring, and the readiness with which energy can be put in and taken out, which recommend the steel spring.

Indiarubber will store much more energy than the same weight of any other material, say, eight or ten times as much steel; but with this several tons would be required to store the horse-power for one hour. A much more capacious reservoir, according to its weight, is compressed air. There are certain difficulties in getting the energy in and out without loss; but with air, compressed to four times the pressure of the atmosphere, we should only require about 20lb. of air to yield the amount of one horse-power for one hour. Of course, if we were going to carry this air about, to the weight of the air would have to be added the weight of a case to contain it, and such a case, in the form of steel tubes, would weigh something like 230lb.; so that, in any form in which we can carry compressed air about, we shall have about 300lb. to carry for each horse-power per hour.

Another means of storing energy, very largely used, is hot water. This is largely used in a way not always recognised. The boiler serves another purpose besides that of converting the energy of the furnace into the power of the steam. It stores the power, and equalises the stream between the fire and the engine, a function the importance of which has been brought to the front in the recent efforts to apply electricity for communication of power, where the want of a similar reservoir between the generator and the motor has, in many cases, proved fatal to the enterprise, a want which secondary batteries are now being used to meet. Hot water has also been employed as an independent reservoir, and as such it is better in some respects than compressed air. The fundamental limits are of much the same kind. In this case, however, the absolute limit is temperature. The vessel in which the water is carried must be strong enough to withstand the pressure, and all materials lose their strength as they get hot. The considerations are here much the same as in the steam engine, and 100° Fahr. appears to be about the limit. At this temperature, for every 4lb. of water the cases would weigh 1lb., and there would be no advantage of large over small cases; except as a matter of construction, the proportionate weight would be the same. The gross power of a pound of water, the steam being used without condensation, is about 20,000 foot-pounds, or we should require 50lb. to store 1,000,000; this is the extreme limit again. The present accomplishment would be about 150lb. per 1,000,000 foot-pounds stored—rather less than compressed air. The only other means of packing power that is at present looked to is that of the much talked about secondary battery. Here there is a great deal of doubt as to what is actually accomplished; take the most reliable statements, from which it seems that in order to get 1,000,000 something like 100lb. of battery is required, which will make this means of storing energy very much the same as compressed air or hot water.

It is important to notice that the initial cost of the energy stored by these means differs considerably. The cost is rather difficult to estimate; but a practical estimate may be formed in this way:—

Taking the power, as delivered by the steam-engine, as 1, how much of this power will be given out after secondary storage? Here the hot water has an advantage, for it is heated directly by the coal, and is all on its way to the steam-engine.

With compressed air there are three operations, each as costly as the steam engine, and at least half the initial power is spent during the compression, storage, and expansion; so that the energy is at least double as costly in coal, and six times as costly in machinery. I have put it down as three times as costly as the energy in hot water, but this is considerably below the mark. The electricity has also to go through three operations, and cannot be less costly than compressed air.

Now, if we revert for one moment to the consideration of the main transmission of power, we see at what an immense disadvantage any form of packed energy is compared with coal or corn; as at present packed it weighs at least 100 times as much.

While the limits imposed by the strength of material render it certain, as far as compressed air and hot water are concerned, that the weight can never be reduced by more than half, these limits are sufficient to show that packed energy cannot be transported over long distances, even if it can be obtained direct from such falls as Niagara. But this is no argument against the importance of these means for short distances and special purposes. As I have already pointed out, our watches show that circumstances may render the very heaviest means the best for particular purposes. And if in any of its forms packed energy were directly available for household purposes, though it cost ten or twenty times as much as power direct from the steam-engine its use would still be assured.

One fact should be noticed, that in all these forms the power is packed, and needs nothing but drawing off, whereas corn or coal do not contain the power. The oxygen is an equally essential ingredient. In this fact lies the great advantage of corn and coal for transportation. They are really, so to speak, but cheques for power, which can be cashed at any spot where a bank, in the form of a steam-engine or a horse, exists. But, of course, not being energy, they are not generally current—in fact they are worthless, except where the bank exists, and where they represent such small amounts that the banks refuse them. Now these forms of packed power are, so to speak, generally current, that is to say, they are available under almost all circumstances, and in greater or less degree of smallness; from the very smallest, which is the watch spring in our pockets, which supplies a continuous stream of power in less than one ten thousand millionth of a horse-power; or the Whitehead torpedo, which carries some million foot-pounds of energy under the sea. Perhaps the most pressing purposes for which these forms of packed energy are wanting is that of locomotion.

The distance which a locomotive body, be is animal or machine, can travel, loaded or free, is limited by the ratio of the power which it carries to its gross weight. The speed which it can attain is limited by the rate at which it can use its energy compared with its weight. Hence there are two particulars in which we can compare the different forms of stored energy for locomotive purposes.

Let us take the horse and the locomotive. A full-sized horse weighs, say, 1,500lb., and, at a rate of 2¼ miles an hour, will go five hours without food, doing about 10,000,000 foot-pounds of work, including the work necessary to move itself; this represents the largest result, or about 150lb. per 1,000,000 foot-pounds. If the horse is put to ten miles an hour, it will not do more than 1·5 million foot-pounds in a single journey, besides moving itself. Probably the greatest rate at which a horse can use its energy is about 4,000,000 foot-pounds per hour, or 750lb. per horse-power.

A locomotive with its tender, say, weighing sixty tons, exerts 500 horse-power gross — 270lb. per horse-power per hour — so that a first-class locomotive with tender is above one-fifth as heavy for its power as the horse; but then the horse cannot go more than ten miles an hour.

Now, in a general way, passenger locomotives carry coal and water for eighty or one hundred miles,

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* Abstracted from the Cantor Lectures, delivered before the Society of Arts.

i.e., two hours; or the locomotive already mentioned expends at one run about 2,000,000,000 foot-pounds; which means that the gross weight of the locomotive is about 60lb. or 70lb. per 1,000,000 foot-pounds of power with which the locomotive starts.

In thus taking the gross weight of the horse or locomotive, we must remember that this includes the weight of carriages and machinery, and that in whatever form the energy is carried this weight must be added. In the locomotive the weight of water and coal in the tender for two hours' journey weighs about one-quarter the gross load; and if we add the weight of the boiler we may consider the carriage and machinery at one-half to one-third the gross load. Taking the latter, and substituting for the boiler, coal, and water, energy in either of the above forms, the coal, water, and boiler would be about 40lb. per 1,000,000: so that, if we took compressed air instead, we should have one-fourth the power; or the engine would run for thirty minutes instead of two hours, a distance of twenty-five miles instead of a hundred. A fireless locomotive might do more than this, say, thirty-five minutes, or thirty miles, at the same speed as the locomotive. Faure's battery, if it could be made to work at all, would carry the locomotive fourty-eight minutes, or thirty-five to forty miles.

These figures seem to show that the locomotive has little to fear from any of these rivals, that is, under circumstances where the smoke and steam are no harm, and where a full-sized locomotive is required. But there are already some cases where the locomotive is required and where the burning of coal is impossible. Should the Channel tunnel be made there will be a great field for some form of packed energy; but it does not seem that the promoters have much faith in a smokeless means of working the tunnel being forthcoming.

Coming back for a moment to Faure's battery, I would carefully point out that the result which I have put down—100lb. per 1,000,000 foot-pounds of energy—refers to what has been already accomplished, and not to any possible limit.

It should be noticed, however, that although the means of doing so are still entirely wanting, could other metals, such as iron or zinc, be used instead of lead, the result would be much greater. This is shown by the relative amount of power necessary to oxidise or deoxidise these materials, which we see for iron and zinc are five or six times greater than for lead; here is an apparent opportunity for art.

But if sciences as yet imposes no limits beyond those I have mentioned, at the same time it holds out no prospect. The chemistry of these batteries has been very deeply considered, and those who have studied the subject most deeply apparently see no direction in which to direct their efforts; so that any great advance in this art must entail a great discovery in science.

USEFUL AND SCIENTIFIC NOTES.

Pouchkoff's Modification of the Holtz Machine.—As well known, the fixed plate of the Holtz machine, as at present constructed, carries *externally* two paper armatures that are charged in order to prime the apparatus. Each of these armatures is fixed at the edge of an aperture through which one or several paper points act upon the movable disc. In order to simplify the construction of the machine, and avoid the always delicate operation of making apertures in the plate, Mr. Pouchkoff, after gluing the armatures on the exterior of the latter, glues the points on the interior and connects the two by a horseshoe-shaped band of paper on the edge of the disc. The machine thus constructed works, according to Mr. Pouchkoff, just as well as one of the ordinary kind.

Sauer's Voltaic Cell.—Her Sauer has constructed a battery that acts only in sunlight. It consists of a glass vessel containing a solution of 15 parts of table salt and 7 parts of sulphate of copper in 106 parts of water. Within is a porous cell containg mercury. One electrode is made of platinum, and is put in the mercury; the other is of sulphide of silver and is placed in the salt solution. Both are connected with a galvanometer, and the whole is inclosed in a box when not in use. When the battery is placed in the sunlight, the galvanometer needle is deflected to a certain point and the sulphide of silver is found to be the negative pole. Any change in the intensity of the light, such as a cloud over the sun, is indicated by the needle. The action of the battery depends on the effect of the chloride of copper upon the mercury. Subchloride is formed, and reduces the sulphide of silver; but this can only take place with the aid of sunlight.

THE proportion of doctors to the population in different countries is given as follows by the *Siglio Medico*:—France, 2·91 per 10,000; Germany, 3·21 per 10,000; Austria, 3·41 per 10,000; England, 6 per 10,000; Hungary, 6·10 per 10,000; Italy, 6·10 per 10,000; Switzerland, 7·06 per 10,000; United States, 16·24 per 10,000.

SCIENTIFIC NEWS.

SUCH observations as have been made of comet Pons show that it fluctuates in brightness in a remarkable manner, and indicate that useful work may be done by taking careful note of its brightness on every opportunity. M. Bigourdan is evidently inclined to the belief that comet Pons at least has a light of its own. The following ephemeris continues that given last week, and will probably enable the observer to detect the comet in spite of the moonlight:—

	R. A.	N. Dec.
	h. m. s.	° ′
Nov. 7	17 17 49	51 27·6
9	17 22 37	51 5·9
11	17 27 40	50 44·1
13	17 32 59	50 22·0
15	17 38 35	49 59·6
17	17 44 29	49 36·8
19	17 50 42	49 13·4
21	17 57 16	48 49·1

Apropos of the result of the Geodetic conference, it may be mentioned that "Bradshaw's" map is in future to have lines ruled at every $1\frac{1}{4}$° of longitude, showing time-intervals of five minutes. In the United States a scheme is on foot for adopting the time-standards proposed some months ago. At present there are no fewer than forty-nine time-standards used on the different railway systems, but it is proposed to divide the whole railway system of North America into five sections, each having uniform time, viz., that due to the 60th, 75th, 90th, 105th, and 120th degrees of longitude west of Greenwich—*i.e.*, if the Greenwich datum is adopted. The 60th meridian will practically be confined to the British Maritime Provinces, but the 90th meridian will be "central time," and will include by far the larger part of the railway system of the country. For many of the cities in the central part of the States local time will be only a few minutes fast or slow of the railway time, and in the ordinary course it is inevitable that the town clocks will be regulated to those of the railway stations.

The monthly meeting of the members of the Royal Institution, on Nov. 5, will be occupied mainly in the election of a manager in the room of the late Mr. W. Spottiswoode, president of the Royal Society.

The annual meeting of the Mathematical Society, on Nov. 8, will be occupied chiefly in the election of the new council, when it is probable that the names of Messrs. W. D. Niven, F.R.S., and J. Hammond, M.A., will be substituted for those of Prof. C. W. Merrifield, F.R.S., and Dr. J. Hopkinson, F.R.S., who are obliged to resign.

At the meeting of the Essex Field Club last Saturday, two papers on Deneholes were read by Messrs. F. C. J. Spurrell and T. V. Holmes.

It is proposed that the memorial to the late Prof. Jevons should take the form of a studentship, of not less than £100 annual value, the holder of which shall devote himself to economic or statistical research. To commemorate the connection of Prof. Jevons with the three cities, the election would be vested in representatives of University College, London; Owens College, Manchester; and University College, Liverpool. A very strong and widely representative committee has been formed.

The telephone patent case in the United States is becoming more complicated. Edison, Voelker, and Irwin have appealed from the decision of the examiner of interferences as regards the claims of Bell; and Edison, Bell, and Gray have appealed against the decision which awarded the telephone receiver to McDonough.

Meantime, the McDonough Telephone Company has been incorporated with a capital of one million dollars, with liberty to increase it to twenty millions.

The Thomson-Houston Electric Company, of Boston, were awarded the first prize for the best arc-lighting system at the Cincinnati Exhibition.

The American Ornithologists' Union was duly organised at the meeting called by Dr. Elliot Coues and Messrs. Allen and Brewster. It will be limited to fifty active members, with power to elect a hundred foreign or corresponding members. One of the principal objects of the Union is to establish a uniform nomenclature for North American birds, and the committee appointed for that purpose consists of Dr. Coues, and Messrs. Allen, Ridgway, Brewster, and Henshaw. Amongst the subjects which will engage the attention of the union is the position of the European sparrow in North America. It appears that he has made himself very much of a nuisance.

According to Prof. Collett the mastodon is a much more recent animal in North America than has been generally supposed. Thirty specimens have been found in Indiana, mostly in marshes or other miry places, some in such good preservation that the bog-cutters used the "fat" to grease their boots.

At the recent meeting of the Society of Anthropology and Geography, held in Stockholm, Baron Nordenskjöld gave an account of that part of his expedition to Greenland which was intended to discover remains of any Norse settlers on its south-eastern coast. He managed to force his way through the ice to a harbour in about 66° N. lat., where fresh traces of Esquimaux were observed and plants found which are common in Greenland only in the neighbourhood of European settlements. The expedition failed to discover any signs of the "populous districts," but is valuable as demonstrating the possibility of reaching a coast which has been rarely visited.

To make their returns complete, the Board of Trade will have to ask for a record of instances of continuous brakes averting accidents. The other day a disaster was avoided in the North by the prompt action of the Westinghouse brake on a train which broke up through being thrown off the metals; and recently an express train approaching Chicago in the early morning was saved from wreck by the power placed at the disposal of the driver by the same pattern brake. The driver noticed smoke ahead, and suspecting danger, applied the brake, which enabled him to pull up within 30ft. of a burnt bridge and prevent the train from plunging into the abyss.

M. Body, of Lecornette, in the Ardennes, has invented a new and ingenious fire-damp detector. It is essentially a safety-lamp of the Davy type connected with an electric bell. Contact is prevented by a catch held back by a cotton wick impregnated with some chemical preparation. When the fire-damp reaches dangerous proportions the wick ignites, the catch is released, and the bell rings. It has been tried with advantage in the mines of Cockerill and Co., at Seraing.

Ericsson's Sun Motor.—Captain Ericsson is engaged upon a motor worked by the solar heat. The rays of the sun are caught and carried to a reservoir, where their heat converts water into steam, which is used for running a small engine. This invention is designed to be used in pumping water on the plains, where its small cost would make it very valuable.

A PATENT has been taken out in Germany for a new process of enamelling ceramic articles. The glass, terra-cotta, stoneware, porcelain, or similar article, is covered with a film capable of conducting electricity, by painting the article with a solution of chloride of platinum or nitrate of silver and burning this in, and then decorating as desired, with enamel. This is burned in, and the article is afterwards covered electrolytically with the metal. The galvanic coating does not adhere to the enamel, and very varied effects can be produced by gilding, silvering, colouring, polishing, platinising, &c., the metallic surfaces of the articles.

M. J. L. SORET brought under the notice of the Académie des Sciences at the séance of the 10th of September, in a note, his interesting researches on "L'Absorption des Rayons Ultra-Violets par les Substances Albuminoides." The *Comptes Rendus*, No. 11, informs us that all the albuminoid substances studied gave a common principle, to which the absorption band is due. Gelatin, though much more transparent, shows no band.

DR. LAUJORROIS in *Cosmos les Mondes* recommends potassium dichromate as an exceedingly useful deodoriser and disinfecting agent. He considers it would be of great use in the treatment of diseases due to microbia.

DR. KOLLER in *Centralblatt für Textil Industrie* draws attention to the fact that if silk tissues are impregnated with chromate of copper, and then exposed to direct sunshine, various shades of brown may be obtained, and the silks are rendered waterproof. This peculiarity of the chrome salts, especially of the chromates of copper and mercury, was published in the Report of the Cork meeting of the British Association in 1843.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

SOLAR PROMINENCES—COMET PONS.

[21983.]—In reply to Mr. Franks (letter 21954), I fear it is simply impossible to ascertain the cause of failure of any arrangement for viewing the "solar prominences" without a personal inspection. In this instance there ought to be dispersive power enough to show the "chromospheric lines"; but he considers eight prisms (direct-vision) the smallest number capable of exhibiting the "cloud" and eruptive prominences, in the manner pointed out in his letter.

Comet Pons.—I was fortunate in obtaining a capital view of this newly discovered body on Saturday morning, 27th October, at about 8.30 p.m. A large nebulous haze surrounded a comparatively small nucleus; but the traces of a tail, if any, were exceedingly faint. The R.A. and N. Dec. were taken from MM. Schulhof and Bossert's corrected ephemeris in your last issue.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Oct. 29.

ERRATA — ε EQUULEI — PAIRS IN CAMELOPARDALIS—PONS'S COMET—δ EQUULEI.

[21984.]—I notice two misprints in letter 21924 page 147. For "rates it at 8·8 mag., Σ remarking," read "rates it at 8·8 mag. Σ, remarking"; and for "The most distinct companion," read "The most distant companion."

The reason that H missed the close pair of ε Equulei (letter 21928, p. 148) was probably owing to the fact that the stars were too near together to be elongated with the 6·3in. reflector in 1780 and 1781, while the close pair certainly was far too difficult in 1823 and 1827 for the small refractors used by Sir J. Herschel. The distance is probably still slowly increasing, Do's measure (0·83″) in 1877 being too small, as might be expected from the character of the telescope used. Two recent measures are: Hall, 285·0°, 1·05″, 1879·7; Perry, 285·0°, 1·23″, 1882·7. The wide pair *n.f.* Σ 2848 is Sh 336 (226·0°, 105·8″, 1823·7). The pair mentioned by Mr. Holmes (letter 21930) near Σ 385 Camelopardalis seems to be new—that is, if it is not Σ 397, as Mr. Franks suggests. Mr. Holmes (letter 21955, p. 471) says that his pair is "just 5′ directly following" Σ 385. Even supposing that he has written 5′ for 5m., a most objectionable practice, yet Σ 397 is 28′ north of Σ 385. There is no star 5′ exactly *f.* Σ 385. Hall gives 0·70″ in 1879·58 for the distance of Σ 400; Seabroke's measures are incorrect, for, unfortunately, the last Rugby results in Vol. XLVI. of the "Memoirs" are very poor. However, they are not so bad as the "measures" (save the mark!) of southern double stars just published in Vol. XLVII., as these are simply disgraceful, and certainly ought never to have appeared in the publications of the R.A.S.

M. Bigourdan has noticed at the Paris Observatory the remarkable variations of light in comet Pons alluded to by Mr. Lane (letter 21931, p. 148). Curiously enough, the French observer says that on Sept. 23rd it appeared in a small telescope as an 8th mag. star, and on the 24th the same, the diameter of the nebulosity being nearly 2′. On the 6th October, the nucleus was as faint as a 12th mag. star; but the comet was more easily perceived than at the beginning of September. Its light on the 23rd Sept. was 30 to 40 times greater than that indicated by theory.

I stated by mistake, in letter 27196, p. 37, that the period of δ Equulei was about 13 years; it is really 10¾ years.

H. S.

CAMELOPARDALIS, &c.

[21985.]—The compositor has put R.A. in letter 21955, where I think I wrote P.A. Mr. Franks will find that the star he mentions is not the one I inquired about as new. My star is in the field with Σ 385 with a high power. I have a wire across e.p., and when I rotated e.p., so that 385 travelled straight along the wire, the new star followed on the wire. The e.p. takes in just 6¼′ of arc, and both stars are in field at once. The R.A., D., P.A., and distance all differ from 397, as given by him. The pair are also smaller than Mr. Franks states, the *comes* being much more delicate than 10·5 I should think. I beg to thank him for taking so much trouble. The air here has been so thick since I noticed this star that estimates both of distance and magnitude are necessarily little better than guesses.

I can assure him that it was not being omitted in Webb that led me to think it new, but the fact of being so near Σ 385, and finding that others had looked at 385 and yet missed seeing this double.

Query 52070. May I query the querist? "Is he sure he perfectly divides δ Cygni with 4½in.?"

I must leave the query of "Vigilans," 52102, to "F.R.A.S.," pleading want of competency on my part to answer it, and a little surprise at finding myself bracketed with your eminent correspondent. I should like to ask if any objection exists to making flats of razor steel. This takes a high polish, which it retains for years undimmed, without any particular care to keep it so; I judge it to be brighter a good deal than speculum metal. Has it ever been used? I recollect it being mentioned to me 30 years ago by workmen, who at that time said they could polish it equal to the finest quicksilvered mirror. In fact, I have seen small hand mirrors made of it. The freedom from tarnish would be a great advantage.

Edwin Holmes.

COMET PONS - BROOKS — JUPITER WITHOUT HIS SATELLITES — RED SPOT OF JUPITER.

[21986.]—On October 20 I saw the comet for the second time, having seen it first on Oct. 4 or 5. I searched for it on several occasions between these dates, but the weather was too unfavourable to see it. Can the variation in its visibility, mentioned by J. Lane, have been caused by the almost imperceptible mist of which we have had so much lately? On clear nights, though not sufficient to render small stars invisible, it is quite enough to blot out so faint an object as a comet or nebulæ. Especially is this mist troublesome on nights like the present; perfectly clear, with the temperature hovering a few degrees above freezing all through the night till 3 or 4 a.m., when it sinks to freezing, and the mist vanishes, crystallised, I suppose, into frost, and planet and moon grow sharp and distinct in every detail.

On Oct. 15, I saw Jupiter without his satellites; but two were really visible all the time, hanging on, one to each limb.

At 15.10 on Oct. 20, after having observed the moon for some time, I turned to look at Jupiter. The indentation in the belt, which marked the position of the once famous red spot, was a little past the C.M.; but no vestige of the red spot could be seen. The thing of beauty has *not* been a joy for ever, in this case.

M. A.

SATURN — ERRATA — DOUBLE STAR NEAR Σ385 — THE BERTHON DYNAMOMETER.

[21987.]—In reply to the question of "F.R.A.S." (letter 21953, p. 170), of course the crape ring should be narrower where it crosses the ball than in the ansæ—the width of it on the planet appeared to me about equal to that of the outer ring at the same point. As regards its want of conformity where it crosses the limb, I had not noticed any peculiarity; but possibly the great difference of aperture would account for it; certainly I never had such views of Saturn with my 5in. achromatic as shown by the 11¼in. reflector; indeed, with the latter instrument I have even seen the cape ring in sunshine.

In my letter (21954, p. 171) I notice two typographical errors. The compositor has made me say "Camelopardalis," a redundant solecism, whereas I wrote "Camelopardus," following, as I always do in these matters, the terminology of my respected friend, the Rev. T. W. Webb. The other mistake consists in introducing an accented "é" into Struve, which I don't think an improvement, as that eminent astronomer always wrote his name as I put it.

I presume Mr. Holmes (letter 21955, p. 171) means 5m. (not 5′) following Σ 385, and that "R.A. 25°" applies to pos. angle 25°? If so, it agrees fairly well with Σ 397, as mentioned previously.

Mr. Perkins (letter 21951, p. 155) makes some startling revelations with respect to the Berthon dynamometer. It is really a very important matter to know that the gauge itself is correct before proceeding to measure eyepieces. My limited experience corroborates his own, and I should not trust any of these instruments unless personally verified by actual measurement with a stage micrometer on the microscope.

W. S. Franks.

ASTRONOMICAL — THE ELECTRIC LIGHT FOR OBSERVATORY PURPOSES—NEW FORM OF LECLANCHE BATTERY—OBSERVATION OF THE SOLAR PROMINENCES.

[21988.]—I am afraid your correspondents, "H. S." (21796), and Mr. Gaudibert (21876), will think me very dilatory in replying to their communications. But I can assure these gentlemen that I would gladly have answered their queries concerning β Delphini and δ Equulei before, had I had anything to communicate. I have on several occasions lately tried to see the respective companions of these very difficult stars, but hitherto without success. The air has been so unsteady, and the seeing so indifferent on every occasion that the weather has permitted the attempt, that I am sorrowfully obliged to say with the needy knife-grinder, "Story! God bless you. I have none to tell, sir." Several times I have had *fancies*, but fancies are not allowed to pass muster in matters astronomical; so that unless I could certainly see and measure the companion, I have confessed myself defeated. And, indeed, no wonder. The moments of good definition are so few and far between on this east coast, that the chances of being able to see and measure such exceedingly difficult stars as these during an apparition are small indeed. I believe all that a telescope can do my 18¼in. Calver will do, as far as its aperture extends; but no telescope in the world can deal with delicate and difficult stars when they are flaring, fluttering, and jumping as if possessed. And such is their normal condition in Northumberland when the sky is clear.

However, to show "H. S." that I have by no means abandoned double-star observation, but, on the contrary, take a very keen interest in this most delightful branch of astronomy, I send my measures of a few stars made during the year, as far as time and opportunities have permitted; and I hope, during the winter, to have a few good nights on which to make some more.

Stars.

1. β 495. R.A. 0.42. Mags. 7·8, 7·5.
P = 225·0°. D = 0·5″. Ep. 1883·80.
2. γ Leonis. R.A. 10.13. Mags. 2, 3·5.
P = 111·5°. D = 3·55″. Ep. 1883·33.
3. ξ Ursæ. R.A. 11.11. Mags. 4, 5.
P = 81·0°. D = 0·93″. Ep. 1883·22.
4. γ Virginis. R.A. 12.35. Mags. 3, 3.
P = 158·0°. D = 4·7″. Ep. 1883·43.
5. 31 Virginis. R.A. 12.35. Mags. 6, 12.
P = 36·0°. D = 3·9″. Ep. 1883·26.
6. 35 Comæ Ber. R.A. 12.47. Mags. 5, 7·8.
P = 66·5°. D = 1·1″. Ep. 1883·31.
7. Virginis 454. R.A. 13.4. Mags. 6·7, 12.
P = 208·5°. D = 5·1″. Ep. 1883·26.
8. 42 Comæ Ber. R.A. 13.4. Mags. 6, 6.
P = 19·2°. D = 0·65″. Ep. 1883·31.
9. 15 Canum Ven. R.A. 13.4. Mags. 5·5, 10·5.
P = 285·5°. D = 1·3″. Ep. 1883·26.
10. 25 Canum Ven. R.A. 13.32. Mags. 5, 7·6.
P = 152·0°. D = 0·6″. Ep. 1883·42.
11. Σ 1777. R.A. 13.37. Mags. 5·8, 8·2.
P = 230·0°. D = 3·7″. Ep. 1883·43.
12. ζ Boötis. R.A. 14.35. Mags. 3·5, 3·9.
P = 115·0°. D = 0·77″. Ep. 1883·42.
13. ε Boötis. R.A. 14.39. Mags. 3, 6·3.
P = 329·0°. D = 2·9″. Ep. 1883·40.
14. ξ Boötis. R.A. 14.45. Mags. 4·7, 6·6.
A.B. P = 268·5°. D = 4·0″. Ep. 1883·42.
15. 44 Boötis. R.A. 14.59. Mags. 5·2, 6·1.
P = 241·5°. D = 5·18″. Ep. 1883·41.
16. 1 (B) Cor. Bor. R.A. 15.14. Mags. 5·6, 6·1.
P = 127·0°. D = 1·23″. Ep. 1883·41.
17. η Cor. Bor. R.A. 15.18. Mags. 5·2, 5·7.
P = 151·6°. D = 0·6″. Ep. 1883·42.
18. μ^2 Boötis. R.A. 15.20. Mags. 6·7, 7·3.
P = 117·5°. D = 0·75. Ep. 1883·42.
19. δ Serpentis. R.A. 15.39. Mags. 3, 4.
P = 190·0°. D = 4·04″. Ep. 1883·42.
20. 49 Serpentis. R.A. 16.7. Mags. 6·7, 6·9.
P = 331·7°. D = 4·1″. Ep. 1883·42.
21. σ Cor. Bor. R.A. 16.10. Mags. 5, 6·1.
P = 205·5°. D = 3·9″. Ep. 1883·43.
22. γ Ophiuchi. R.A. 16.24. Mags. 4, 6·1.
P = 36·5°. D = 1·62″. Ep. 1883·43.
23. ζ Herculis. R.A. 16.36. Mags. 3, 6·5.
P = 98·7°. D = 1.42″. Ep. 1883·48.
24. No. 528 in Gledhill's "Handbook."
R.A. 16.40. Mags. 8, 8.
P = 87·0°. D = 0·4″. Ep. 1883·43.
25. δ Cygni. R.A. 19.41. Mags. 3, 7·9.
P = 323·0°. D = 1·23″. Ep. 1883·54.
26. β 696. R.A. 21.58. Mags. 8·5, 9.
P = 354·0°. D = 0·5″. Ep. 1883·80.

I can fully bear out what your different correspondents have from time to time said as to the great advantages of the electric light for obser
tory purposes. I first tried the bichromate
but I found the trouble of lifting the
out of the fluid so great, when you w
means to save time, that I cast
better form of battery. This Messrs
Swan, of Newcastle, have supplied

being sold for half a guinea an ounce, is scarcely worth sixpence."

Again, a dealer has sent me samples of what appears to be very fair "block tin," saying, As the regular chemical analysis is rather a long business, and I am very busy at present, would you mind examining it pyrologically for *lead* with your blowpipe, and send me the result?—You will find inclosed a considerable quantity of *brown oxide of lead*, derived from your block tin, in the following manner :—(1) Fragment on C. slip, Al plate ("E. M.," Figs. 11 and 46) H.P. The red-hot assay, which at once fuses to a ball, must be kept with a shining surface, by covering it carefully with a good blue H.P. (*a*) Whatever lead alloy may be present in the assay will be sublimed, and deposited as a white sublimate on the vertical surface of the plate, where it turns *brown* in P.P. (*lead*). (*b*) When all lead or antimony, &c., has been thus extracted, and no further *separate* sublimate can be obtained, an O.P. *on* the assay will at once cover it with a kind of efflorescence of snow-white pure tin oxide, on which P.P. has no further effect than turning it yellow while hot. This pyroxide (SnO_2) separates the large flakes, and can be thus rapidly collected and re-formed, until no metal is left. This oxide can, of course, be reduced to chemically pure tin.

"Last, not least," a faithful study of Pyrology will bestow upon the student a severe training in the mental analysis of *any* subject, whether chemical, political, or literary, which will enable him (with, *à priori*, a due knowledge of the particular subject at issue), to rise, if he have natural talents, to the very top of the nationalistic tree; for, as in evolutionary organisation, so in the analytical process of the human mind, nature has only one method of pushing forward from the bare protoplastic fact given to be detected, by parallel, analogical, and inductive supplements (supplied, of course, more copiously by the more original mind), and rise to perhaps brilliant and novel conclusions or *facts*, which might even alter or correct, and must certainly benefit the knowledge of the whole thinking world.

As an illustration of the application of how the mental part of this method of analysis to the solution of a purely literary problem, the authorship of the "Vestiges of Creation," it may be mentioned here, that overwhelming proofs can be, or rather have been, afforded (in plain English), that the late Dr. Robert Chambers could not possibly have been the author of that celebrated work; and, in a second part of the essay or assay, other proofs scarcely less convincing, that the author was no other than the late Sir Charles Lyell. Both these conclusions have, since the essay was written, been verified. 1. Mr. Churchill (publisher of the book) has distinctly stated that Chambers was *not* the author. 2. Sir C. Lyell, in a letter to Prof. Haeckel, as good as admits that he *was* the author. **W. A. Ross.**

MICROSCOPE MOUNTING.—SLIPS AND MICRO-COVERS.—I.

[21992.]—To begin quite at the beginning, microscopic objects are mounted—i.e., preserved so as to be always ready for examination—by fixing them on a slip of glass or wood, and protecting them by a covering glass. Of mounting on wood, I have no practical experience; but it would evidently be useful in two cases—at least for those who are in the way of cutting the wood of the proper size and shape. Firstly, it would do as well as glass for opaque objects, and, indeed, for all objects which are intended to be seen by reflected and not by transmitted light—that is, practically, by the bull's eye and not by the mirror. Secondly, minute objects may be mounted in air or Canada balsam between two covering glasses, and fixed with gold size or some other cement on a wooden slide, in the centre of which a hole has been cut to receive the light from the mirror or condenser. This arrangement gives the power of bringing the condenser quite close to the object. Hard and fine-grained wood should, I presume, be employed. However, glass slips have to be resorted to for the great majority of objects, and, for the sake of uniformity, are commonly made use of for all. They are three inches in length by one in breadth, and average a little more than a sixteenth in thickness; the thinnest should be kept for objects which it is intended to observe with high powers, as a condenser cannot be so conveniently used through thick glass. They are, according to Dr. Carpenter, made of "patent crown" glass; and they should be free from scratches, bubbles, or other marks—at least in the centre where the object is to go. Anyone who has the necessary facilities may of course cut "patent crown" into the above shape, and grind down the edges; if not, ground-edged slips can be bought for about 8d. a dozen, and unground-edged at about half that price. I would recommend the purchase of, say, a dozen unground slides to commence with, and the subsequent use of ground-edged to prevent scratching.

Covering glasses are cut with a diamond from very thin and brittle glass, by laying it on a sheet of wet plate glass. They are generally sold in ¼-ounces, at the rate of from 4s. to 8s. an ounce, and of three thicknesses:—No. 1, very delicate, and requiring to be most carefully handled, for high powers and test objects; No. 2, medium; and No. 3, thicker, and made of exceptionally large sizes, for live-boxes, &c. Squares and circles are the usual shapes, and the circles are a little dearer than the squares, but, I think, more convenient in any case, and certainly much more so if the mounter has a circle board, without which he will find it very difficult to mount neatly. The vendors will mix different shapes and sizes, and a ¼oz. will last a good while; the most useful sizes are ¾, ⅝, and ½in. The contents of a ¼oz. box will often be found of very different thicknesses, even if they have been bought as all of the same kind. After a while, they are easily distinguished by the feel; and a few of them may be measured with a micrometer to begin with. Those of ·003in. are thin enough for all purposes. For exceptionally large objects special slips must be procured or cut with a diamond, and, if thought necessary, ground at the edges. Again, the objects may be mounted lengthwise, and special covers, longer than they are broad, are made for mounting such objects; or, for inspection with very low powers, they may be mounted between two slips.

II. *Ringing.*—Mounting is either in (1) air, commonly called dry mounting; (2) resinous substances, as Canada balsam; (3) syrupy fluids, of which by far the best is glycerine; or (4) thin fluids, which usually contain corrosive sublimate. The resinous substances gradually dry and harden, and the slip only needs to be cleaned before mounting the object; but in the other kinds of mounting it is always advisable previously to make a well on the slip of the shape and size of the covering glass which it is intended to use, so as to prevent the object from being unduly pressed on, the fluid from running out, and the cement or varnish from running in. To make a "cell," as the little chamber thus formed and inclosing the object is termed, it is first necessary to clean the slips, as neither cements nor varnishes will adhere firmly to dirty glass. This may be done by washing them in warm soap and water, then in pure warm water, and, finally, if any dulness or specks should remain, rubbing them with a cloth moistened with methylated spirit. They may then be dried with a clean rag, and brightened up with that invaluable thing in microscopy, a clean, soft old silk handkerchief. The next step is accurately to find the centre of the slips, which may easily be done with a circle-board or turn-table, or without it in the following manner:—Lay a slip on a piece of white paper or cardboard, and draw four fine lines round the slip, using it as a ruler, and taking care to hold the pen or pencil upright, or so to use it that the lines on opposite sides of the slip shall be at the same distance from its edge. Do not draw the lines quite to the corners, but take away the slip, and continue them by a ruler till they meet, which will give opposite corners more exactly than if the slip itself were used. Then draw two lines exactly from upper right corner to lower left corner, and from upper left corner to lower left corner. The point where they meet will be the centre of the slide, and should be marked by a dot. If then any slip which is nominally 3in. by 1in.—for the slips naturally differ a little in size—be placed over the figure thus drawn, so that its opposite sides are over or at equal distances from the lines left by placing the original slip on the cardboard and drawing round its edges, the dot will be under the centre of the slip. Make then another ink dot just over it, on the slip itself, holding the eye perpendicularly over the slip, so as to mark it straight. These marked slides will be especially useful in mounting in resinous substances or air, the object being mounted on the other side of the slips and the dot made on the bad side, if there is one. Parallel circles or squares may also be drawn an the cardboard round the dot, an eighth or so of an inch apart. Being seen through the glass, they will help the eye in drawing a square or a circle on a slip.

The next step is to draw a ring or circle with a brush dipped in cement. Cements, by the way, are different from varnishes, which are neatly or showily coloured liquids, 'intended for finishing off slides, as slips with mountings on them are called, from their being slid on the stage of the microscope. Cements have greater tenacity; and the most trustworthy are marine glue, gold size, and Bell's cement, among which gold size is preferable in practice, as it can be used without heat. The first thing to see to is that the cement (which must be of thoroughly good quality) is neither too thin nor too thick. If too thin, it will tend to run on the slip, and must be laid on in correspondingly thin layers; it will thicken in time, or by leaving the cork sideways in the bottle. If too thick, it will not run or will leave threads behind it; and ought to be thinned, gold size with turpentine or benzine, and Bell's cement with spirit. Only a few drops of the thinning liquid should be added at once, and the bottle shaken, for it is easy to add more, but impossible to remove what has been added. The liquids appropriate for thinning varnishes should be inquired when the varnishes are bought; they are usually turpentine and benzole, and are generally marked on the bottles. For cements, a small camel's hair pencil may be used; but for varnishes more delicate lines can be traced with a small sable pencil. All pencils should be cleaned after use in the liquid appropriate for thinning the varnish or cement, and special care should be taken of sables. They may be kept from becoming harsh by being moistened with tallow, being cleaned with turpentine before use. In drawing a cell, the brush should be well moistened with gold size, or whatever else is used, but not so as to drip; and if it threatens to do so, it may be held upside-down for a moment or so. The pencil should touch the slide at an angle of 45°, or rather less, and at a tangent to the circle to be formed—I say circle, because a circular cell is more easily made than a square. If a turn-table is used, the faster it is made to rotate the better, within reasonable limits, the slip being fixed so as not to fly off. In this way cells of $\frac{1}{16}$in., or thicker, may be made with ease; but only thin layers should be laid on at once, and a new layer should not be added till that beneath it is of a quite waxy dryness. For thicker cells, a single layer of gold size may in the first instance be laid on the glass as just described. Then a button-ring—a brass or vulcanite ring, or a slice of glass tube—should, when the layer is waxy, be coated by a brush with gold size on one side, laid by that side on the layer, and firmly pressed down with as much pressure as can be used without breaking the slide. It should then be left to fix by the drying of the size. In this way cells of any depth may be constructed; but it is better not to use (as sometimes recommended) paper, or wood, or readily-corrosible metals. If the objects are to be mounted in air, nothing more need be done, except, perhaps, to clean away any superfluous cement by a rag or a piece of cotton wool stuck on a stick like a minute mop, and moistened with spirit. If they are to be mounted in glycerine or thin fluids, the interior of the brass or vulcanite should be carefully and entirely covered over with gold size, so as to prevent possible corrosion. No spaces by which dust can get in, or, in wet mounting, fluid escape and air penetrate, must, of course, be left between the ring and the glass. The cement of the rings should be perfectly dry and hard, so as to be almost chippy, before a covering glass is put over them and an object mounted; otherwise they are apt to run in, or to lose their shape. Their tops must be of the same height all round, without irregularities, which would break the covering glass, or leave spaces between it and the top of the cell. Any slight irregularities left after the ring is first made will disappear on laying it quite flat. The size of the rings ought to be calculated by that of the covering glasses to be employed, which should reach quite to, or a little beyond, the middle of the ring, but not to or beyond its outer margin. When an object is to be mounted—say, when the apparatus is being got out—a very thin layer of gold size should be applied to the ring, to soften it, and enable the covering glass to be pressed down into it so as to fix it, and to prevent the minute interspaces which are the demons of wet mounting.

No cell, remember, should ever be deeper than it is necessary to make it. The object should touch the slip on the one hand and the cover on the other, so as to fix it in the centre of the cell, except in air mounting, or where brittle objects are in hand. And, again, the larger the circumference of the cell, the greater is the danger that some defect may occur.

III.—*Finishing, Varnishing, Labelling, and Cataloguing.*—Omitting for the present the description of the process of mounting itself, about which many mistakes would be made as to selecting objects, staining them, &c., if I were to attempt to describe it here, I will conclude with a few remarks on the above subjects, taking up in my next communication the preliminary examination of objects. Mounted slides may be cleaned from superfluous Canada balsam, or whatever may have been used, by rubbing the slip with a cloth moistened in turpentine or benzole. The covering glass may be cleaned in the same way, but *very* carefully; and they may be finished by cleaning with methylated spirit. If Canada balsam or any other resinous substance has been used, the rough of it should first be taken off by a small-bladed penknife. The slides may then be varnished, but it is distinctly better not to varnish them; and if it is desired to do so, for the sake of neatness, two months, or even more, should be allowed to elapse before it is undertaken. The process of varnishing is precisely the same as that of ringing. To save lengthy description, I would recommend the reader to inspect at a shop some of the best-looking slides prepared by professional mounters. Zinc white, and black, red, green, and gold Quekett's varnish are the best and most commonly employed; they are laid in a ring over and round the edge of the covering glass, so as to look neat and cover defects.

For Canada balsam and other resinous mounts, the best varnish is a ring of Canada balsam and chloroform thus laid on. After another couple of months or so it may be covered by any other varnish. Again, white may be laid down as a ground, and black lines put over it, or green lines (circles) may be drawn over the yellow of the gold size; and so *ad infinitum.* The varnishes may also be used to indicate at a glance the character of the slides; thus green may be used for plants and red for animals; but as to things of this kind everyone will devise plans for himself, and perhaps take the trouble of carrying them out. I will afterwards give receipts as to labelling. Ornamental paper covers for slides are sold; they are best left alone, as if either the mounting goes wrong or the first labelling should have been inaccurate—and both of these things are possible—they have to be painfully taken off. The best thing is two paper labels, one near the top, carrying a description of the object, and another near the bottom, with a number or other detail. These labels are best made of stiff paper, not white, as they become dirty, but tinted. The greenish blue Society of Arts paper does admirably; it may be gummed, and the labels punched out or cut to shape with a pair of scissors. The gum should have a little glycerine in it to prevent it from becoming too dry, and three grains or so of corrosive sublimate, with a few drops of oil of cloves or some other essential oil to hinder it from growing mouldy while in the bottle. It should not be two thick, and two coats may be laid on. Labels such as drapers use may also be bought. I do not like a square label, as they are apt to rise at the corners, but a small circle for the bottom, and an ellipse or oval at the top, with an inscription in three lines, the upper curved upwards, the middle straight, and the lower curved downwards, so as to follow the shape of the label. The labels should be written on before being fixed on the slide, which may be done by carefully moistening the gummed surface only, and pressing them down with dry blotting-paper. As little as possible should be written on the labels, reserving a fuller description for the catalogue, as it is easier to write in a book than on a morsel of paper. The catalogue may be a fourpenny or sixpenny notebook, written on one side of the page, with three or four lines between each item left blank for additions. It should give (1) the number, (2) the nature of the object, (3) the method of preparation and the nature of the mounting employed, and (4) what is shown—failures, defects, and mistakes being plainly set down.

I give in illustration a couple of labels and the corresponding entry in my catalogue. *Upper label:* striped muscle (from leg of) blue bottle. *Lower label:* 93 G. *Catalogue:* "93 G, striped muscular fibres, M.F. $\frac{27}{19}$, from femor of bluebottle, showing an apodème. From undue pressure, most of the fibres have broken off, and some have partly split longitudinally, over lines of nuclei, from same cause. An unbruised batch, M.F. $\frac{31}{14}$. OsO_4 [Osmic acid] and glyc. [glycerine]. Tracheæ dark." M.F. refers to the numbers on "Maltwood's Finder."

F. G.

EQUATORIAL MOTION FOR TELESCOPE STAND.

[21993.]—I HAVE received so much pleasure from adopting Lord Lindsay's method of giving an equatorial motion to a telescope on an altazimuth stand, and have accomplished it so cheaply and so effectually, that I fancy many users of the telescope will feel interested in reading an account of it.

The telescope is a silver-on-glass Newtonian reflector, of 15in. diameter and 100in. focus, in a square wooden tube 9ft. long, carried on an iron ring 4ft. diameter, hung on an iron fork by two strong screws or trunnions, one through each end of the fork, and turning on them; the spindle of the fork turning in a strong iron tripod, and carried on a point on which it turns.

The tube with mirror and flat and eyepieces is counterpoised by two half-hundredweights hanging on the bottom and in the hollow of the fork, so that it will stand in any position in which it is placed, and it can be pointed to ten degrees from the zenith. A few pounds' weight are then added to the mirror end of the telescope, and the tendency of the front to rise is regulated by a string running through pulleys, between the telescope and an arm fixed on the spindle on which it turns, and thence to a gimlet in the side of the telescope near the eyepiece; and by pulling or loosing the string—it running over the shank of the gimlet—the telescope is pointed as high or low as required, and fixed by a turn of the string round the shank of the gimlet, and then in a nick in the handle. A pull of 1½lb. will move the telescope in azimuth.

A meridian line is marked from the spindle on which the telescope turns, and on this line a loop is fixed, just as far south of the spindle as for a line from it, the loop, to the centre of motion, on which the telescope rises and falls, and turns to point to the Pole.

To this loop a line is attached, and when connected to the front of the telescope and the telescope hanging on it at any and all elevations, an equatorial motion is given to the telescope, and a star followed by one motion of the telescope to the west. In fact, the loop and the axis of the telescope form a Polar axis, and when the front of the telescope is attached to the string and the string kept tight, it is an equatorial, and has the advantage over the usual equatorial stand, that the eyepiece is always horizontal when the telescope is pointed east or west. When on the usual equatorial stand, the eyepiece is turned down when the telescope is turned due east, and up when west.

The loop being properly placed, and the string from it running through a screw eye fixed in the middle of the bottom front of the telescope, a star or planet to be viewed is placed in the telescope in the usual manner.

The meridian string is then pulled tight through the screw eye, and thence to a second gimlet in the side of the telescope passed round the shank and made fast in a nick in the handle. The other string and pulley that have kept the telescope at the proper height may then be loosened, and the whole pull of the telescope be maintained by the meridian string. If, on looking into the eyepiece, the telescope is too high or too low, a turn of the gimlet will set it right, and the star will be followed by moving the telescope to the west as the star moves.

So far good if the star is on or near to the meridian; but if much to the east or west, the telescope will have a tendency to fall into the meridian owing to the pull of the meridian line.

To counterpoise this tendency of the telescope, I have a lever fixed to the spindle of the stand on which the telescope turns, and from it a string running through a pulley is attached to another lever, one end of which is hinged to the side of the room so as to rise or fall parallel to it, and a weight is put on this lever, and the string so adjusted that the lever is upright when the telescope is on the meridian, and falls as the telescope moves to the east, so that the pull of the string exactly counterpoises the telescope in every position east of the meridian. The motion of the telescope with the star is caused by the pull of another string on a second lever fixed to the same spindle of the stand, and regulated by the descent of a weight carried on the top of an air bellows, filled with air, and the outlet connected to a flexible tube, having a cock at the end which is placed near the eyepiece of the telescope, and the descent of the weight and motion of the telescope increased or lessened as desired, by opening the cock more or less. When the telescope is west of the meridian, the pull is in the contrary direction, and the string is passed through another pulley so as for the lever to fall and the weight to increase as the telescope is farther from the meridian, and it is equally counterpoised in every position.

The levers that turn the spindle, and which I state are fixed to it, are, in fact, fast-and-loose levers, fixed in a minute in any position, or removed altogether. They may be likened to large nutcrackers or lemon-squeezers, fixed to the spindle by a screw through the handles, and having a groove cut in them near the joint to nearly fit the spindle; they hold it perfectly tight, or, when unscrewed, lie loose, and the spindle is easily turned in any direction.

I make these levers very cheaply thus. A 3ft. length of 2in. square deal has a second piece of the same size, 2ft. long, hinged to it by a long screw passing through an oblong hole in the shorter piece, and screwed into the longer about 1in. from their ends. The screw is long enough to allow of the levers being ½in. apart—when the spindle is in a groove cut 5in. from the ends—and a shutterscrew (may be bought at any ironmonger's for 6d.) passes through the shorter lever at its other end, and screws into the nut fixed on to the longer lever—and a turn or two of the screw fixes the lever fast on the spindle. If inclined to slip, a little chalk will be an effectual remedy. These trifling and cheap additions to my telescope have added immensely to my enjoyment of it—as by the clock-motion a star may be kept any time in the centre of the field of view by an extremely small motion of the cock. To easily regulate this, I put the end of the tube (which I purposely fix to the cock) into a little water held in a tin vessel hanging on the telescope, and the noise of the bubbles of air as they escape from the tube into the water enables me to regulate the cock to the greatest nicety.

I am aware that in the usual stands for the Newtonian telescope the balance of the tube is to the eye end, and they are supported on a rod that is raised or lowered by a screw; but the same motion may be given to any one fixed in an observatory by a sliding rod fixed to a hook in the floor, and to the front of the telescope by a second hook, and sliding longer or shorter, like the legs of a camera stand, and I feel sure no one would be without the bladder clock who had once experienced the luxury of it.

Another addition to my telescope may be worth mentioning. Shutters are hinged to the inside of the tube of the telescope—each one having a hole in its centre to act as a stop—and a string fixed to the lower corner and passed through a hole in the lower side of the telescope, and thence round the bottom of the telescope, and through another hole in the opposite side, and then fastened to the same corner of the shutter. It is readily pulled across the telescope or back into its place, so that a stop is put on or taken off the mirror in the readiest way. I have two such in my telescope—one with a 9in. hole, and the other with a 7in. hole in it; and I find them very convenient, as they can be pulled across while the eye is at the eyepiece, or back again as desired. I ought to state that the star should be south of due east or due west; but if north of that, the meridian line should be fixed to the mirror end of the telescope, and at the top of that end. The balance weight should also be placed at the eye end, and all other arrangements reversed. This, however, I have never tried.

The position of the loop on the meridan line may be readily found by observing that if the telescope rises faster than the star, when observing a rising star, the loop is too far from the spindle; or if the star rises faster than the telescope, the loop is too near to the spindle. A few trials will soon indicate the true position; also that bricks are cheap and useful weights.

Philip Vallance.

THE PARKER-SMITH AUTOMATIC SCREW BRAKE.—TO MR. STRETTON.

[21994.]—WITH reference to your letter, page 154, I would explain that no personality was intended when alluding to your objections to mechanical brakes. You have doubtless had many opportunities of witnessing the trials of chain and friction brakes, and observed their unsuitability to general adoption, and therefore have every right to the opinion you have formed.

I must, however, object (with, I am sure, the large majority of our readers) to the statement that "*mechanical brakes* have had their day." In fact, several to whom I have referred this opinion have remarked, that they did not think it had *commenced* yet. Certainly many inventors are hard at work on this question, which would hardly be likely if it was thought that the ultimate perfection in mechanical brakes had been realised.

If any inaccuracy has occurred in my letter, page 132, pointing out the several little deficiencies requiring improvement in the air and vacuum systems, I shall only be too happy to be corrected. I acknowledge my failure when attempting to describe the Heberlein brake; but this was partially due to the printer omitting a couple of lines and perverting the punctuation. A very excusable error. Mr. S. seems to attach very considerable importance to the Board of Trade recommendations, and no doubt very rightly. They, however, are not entirely coincided with by some engineers. The Westinghouse brake is probably the only one that follows them in their entirety; but, as I have remarked before, there are several conditions and improvements—or rather, I should say, the absence of several defects required before the present forms of air and vacuum brakes will fully satisfy our engineers. There is no portion of the Board of Trade conditions which cannot be fully realised and fulfilled with the P.-S. system; and there are several very necessary qualifications not included in the Board of Trade conditions that this brake also possesses. Not the least amongst these is its adaptability for shunting purposes when disconnected from the engine—a difficulty Mr. Stretton suggests. As the sliding of a 15lb. weight on an inclined lever entirely controls the braking force on each carriage, a man could stand on the footboard and linking any portion of the chain on the hook provided, could control the brake as easily as the engine-driver or guard. This is one of the great advantages of mechanical brakes over air systems, which are of course useless when detached from the engine. It is absolutely essential that any train fitted with the air system is also supplied with the hand-screw brake in the guard's van to assist in shunting, and fall back upon when the air brakes fail. Of course the liability of the servants to forget to couple the brake chain would not be confined to the Parker-Smith system: they can forget to couple the brake connections in any system ever invented. Should, however, any individual carriage be linked up as described, and not coupled up, such carriage alone would be affected. On the other hand, were the fireman to omit to open a tap between the tender and first carriage, the whole train would be practically unbraked.

As regards the danger of the chain pulleys freezing up in winter time, this difficulty would mostly apply to a brake like the chain brake on the L. & N.-W. Railway, which being an emergency brake, may run for hours with the chain slack in the pulleys without being used. In the P.-S. brake the chain always being in tension, with a slight movement corresponding to the motion of the train, and the fact of it always being the stopping power, would reduce this contingency to a minimum.

Though the Westinghouse brake has the advantage of having all moving parts covered, it is found necessary to carefully drain them to prevent their freezing up; so I think mechanical brakes may be entitled to a litte attention.

In cases of the train breaking loose, I believe it is intended that all brake couplings should part without injury, or at least so little as to be easily repaired. With the P.-S. system the limit of damage would ensue. As an iron rod is substituted for the chain under the coach, whose longitudinal motion equivalent to the rising and falling of the weight is controlled by two collars, it follows that the weakest point will be the S, or attaching link, between the coaches. On the train separating, these S links would partially straighten, allowing the chain to disconnect, the weights would immediately fall, applying the brakes with full force, no damage resulting to the apparatus.

I think it may safely be granted that "the simplest means of securing a result being the best," is a fixed mechanical law, and that neither continuous brakes or railways should be any exception to it. I do not think that a trustworthy complication need be necessarily sacrificed to simplicity, *providing you secure the efficiency*. A continuous brake is certainly intended to be a life-saving apparatus, though it has occasionally proved the reverse. Simplicity is a very necessary feature in a continuous brake, especially regarding the rough work of railway service, yet it is not everything. Mr. Stretton mentions the old lever brake on coal waggons as an example of a simple brake. This, however, does not apply, as it could not be regarded as a continuous brake, neither does it fulfil the necessary conditions. I have no doubt Mr. Stretton will admit that the *theory* of every train or coach developing its own retarding energy is correct and sound in principle. The difficulty has been to arrive at this result practically, as the failures of the various trials mentioned by Mr. S. fully testify; but this, of course, does not alter the principle. A train should be stopped with the same ease and certainty that it is started; this is all the more necessary when we consider the high and increasing speed now obtained. It is not a comfortable reflection to travel at 60 miles per hour with the knowledge that the brake may or may not act. With mechanical brakes, as the momentum of the train at whatever speed, supplies in proportion the equivalent energy to check the train, it follows that the power is *always* available when required. I would also point out that a "screw" (the combined elements of mechanical principles) differs very greatly from a simple arrangement of friction wheels which wind a chain round a drum—the method of most so-called mechanical brakes.

The Parker-Smith brake may be described as a continuous hand-screw brake. Instead of the guard, the axle turns the screw, and by means of the connections this operation is simultaneously repeated on every vehicle provided with brake apparatus. All the engine-driver or guard has to do, is to let out as much chain equivalent to the braking pressure he wishes to obtain. The effect of this is to lower the weights on each carriage an exactly similar distance (as each is provided with the same length of chain), and regulate the pressure between the friction cones, causing the screw to revolve with more or less force; and carrying the part nut (working the brake levers) in either direction from the centre of the screw according to the direction the train is travelling. On pulling up the weight the part nut is disengaged from the screw and the brakes at once released. The screw brake can be applied at frequent intervals or kept on *ad infinitum* without fear of exhausting reservoirs or overworking donkey pumps. The screw brake is again free from the annoyance, drivers using the air-brake often experience and express, at large stations, when a number of vehicles uncharged are added to the train. The brakes on the latter at once fly on, the starting signal is lowered, and the driver finds himself unable to move till the pressure throughout the train is equalised. In large stations with heavy traffic this defect is apt to cause inconvenient delay. Under all these circumstances I think it is rather premature to insist that mechanical brakes have had their day and must now give way to better inventions, as we most certainly require more definite evidence that they exist. I should be pleased to observe the opinions of our mechanical readers on this subject. **Imprimatur.**

A "PATENT" FILE.

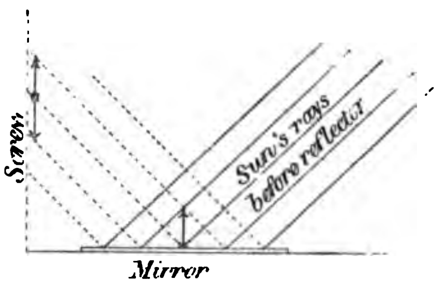
[21995.]—While I was in a shop this morning an idea occurred to me which I expressed to the assistant—viz., Why should not a file be made in the shape of a grindstone? I had been spending 20 minutes the same morning in filing off the ends of six screws which came through a piece of wood, and, in addition to trying my temper, it made my fingers ache. If I had had a *circular* file, I could have done it in a minute or two, and been smiling all the time, by placing the ends of the screws against a circular file fixed to a grindstone and giving the handle a few turns. I asked the man in the shop why such a thing was never made; but as he answered not, I suppose he did not know. Perhaps some of your readers can tell me? If such a thing *can* be done, and somebody will kindly make one (*without* patenting it), and let me know, I should be indebted, provided they don't put an exorbitant price on it. **L. B. B**

SHADOW v. MIRAGE.

[21996.]—If Mr. S. Ratcliffe will stand a small object (as a screw) upright on a horizontal looking-glass, in sunshine, and hold a sheet of paper vertically at a few different distances from the object, yet so as to receive the reflected rays, his difficulty will at once vanish.

Our good F.R.A.S. will forgive me for pointing out that he has only considered the rays of the sun falling on the water *between* the object and the screen—an easy oversight when one is working *currente calamo* as he does.

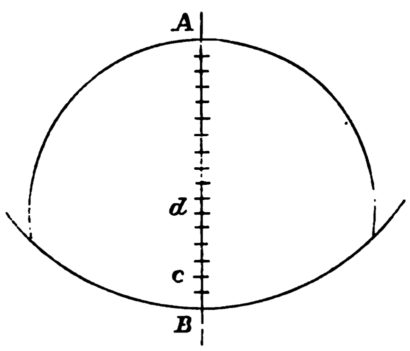
I send a diagram for Mr. Ratcliffe which he can have by applying to you, or which you can print if you think proper.



I may add, perhaps, that if the object be very close to the screen, we get the direct shadow also, so that we may have portions of three shadows on the screen at once. When "S. R." moved to the middle of the stream, of course this direct shadow fell on the water, and it is the reflection of this, as it were, that forms the reversed image on the bank. **Bow.**

THE EYE OF THE FLEA.

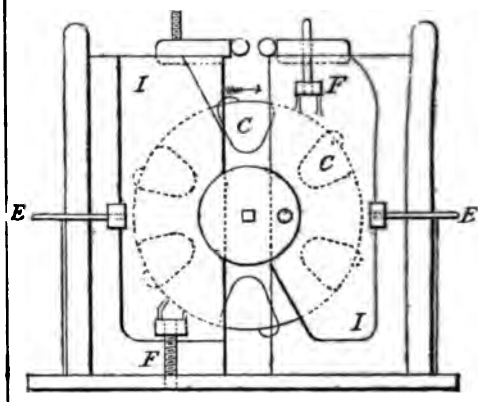
[21997.]—The poet has said, "The toad wears a precious jewel in its head." ("As You Like It," act 2, scene 1.) In whatever part of the head it may lie, and however beautiful when found, it cannot surpass, in lustre and beauty of setting, the eye of the domestic flea (*Pulex iritans*). When viewed under a power of 200 or 300 diameters by reflected light, it presents a crystalline lens about $\frac{1}{300}$ of an inch in diameter, surrounded by a dark brown or black rim, and sunk in a depression of the rich chitinous covering of the head. If the light be judiciously applied, this combination of bright light in the lens, with the middle tint of the surrounding yellow skeleton of the head and the dark supplied by the black rim—these being harmonised and blended by the shade and shadow of the depression, and assisted by the harmonious curve which bounds its dorsal margin—presents a combination worthy the study of the trained eye of the artist.

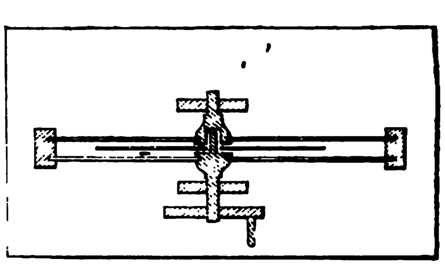


Its lenticular properties can be demonstrated by mounting the lens in balsam, and using it as an ordinary transparent object with the microscope—say, three yards in front of the room window in strong daylight—by attaching in the centre of one of the squares of glass some sharply-defined object—say, a Greek cross 3in. or 4in. big; then, with flat mirror and condenser, direct the image into the focus of the lens of the eye, and viewed with an objective of medium power, will show a very reduced image of the object on the window; or if by lamplight, with the microscope placed horizontally and the mounted lens on the stage, place a sharply-defined object—as a portrait on glass—about 3in. diameter and 10in. from the stage, with good lamplight condensed upon the picture by means of the bullseye. The light and picture being coincident with axis of tube, then with the achromatic condenser beneath the stage the image may be focussed with the lens of the eye, when, with a $\frac{2}{3}$in. or $\frac{1}{4}$in. objective, an image of the picture may be seen in miniature, demonstrating the eye to be lenticular; and by cutting sections of the lens, it is seen to be a double-convex, the curvature of the inner face being much quicker than the outer—the difference of the radii being about as 11 to 16. Thus, to produce a diagram of a section through the axis showing the relative proportion of the radii of the two surfaces, lay down a vertical line A B any convenient length to represent the desired thickness of lens, which divide into 17 equal parts; set off one part, B to C, making C the centre for the outer surface, as shown at A. Again, from B set off 11 parts as at *d*, and describe the curve B, which represents the inner surface. **T. P.**

VARLEY'S INDUCTION MACHINE.

[21998.]—I inclose elevation and ground-plan of a modification of Varley's induction electrical machine, arranged so as to avoid mechanical difficulties, and bring the construction within the reach of a schoolboy handy with his tools. A disc of ebonite, having on each face six carriers of tinfoil, rotates within two pairs of varnished glass plates, not more than $\frac{1}{2}$in. apart. The projections of the carriers rub against four brushes of metallic wire, two connected with earth by strips of tinfoil down the side supports, and two insulated, the lower on a strip of ebonite, the upper resting on the glass plates. The feeders F are in metallic connection with the tinfoil inductors, covering the middle of the outside of each glass plate. The cost of the ebonite disc may be avoided by using strips of glass, or ebonite penholders, to support the carrier.





Adelaide, S. Australia, Sept. 10. **T. D. S.**

A SHORT PAPER ON CARPENTRY.

[21999.]—I would like to supplement "O. J. L.'s" remarks on page 119 with a useful wrinkle or two. In the first place, I would not advise anyone to use any of the arrangements for holding tools to be ground upon a grindstone, because if so held they will be ground hollow, and their cutting edges will not stand long; whereas, by holding them in the hands they will be slightly rounded, which is the best form for maintaining the cutting edge. Then I would have two set-stones—one to be ground and kept perfectly flat, for plane irons, chisels, &c.; and the other for sharpening such things as sprig bits, drills, gouges, &c., which usually leave most workmen's set-stones in a disgracefully uneven state. Note that when a smoothing-plane or trying-plane iron is sharpened perfectly flat the corners should be slightly rounded off on the set-stone, or they will leave ribs on the work. But the most important omission that I find in "O. J. L.'s" directions is this: whenever a close-fitting joint is required the operator should have a good old knife, with the end ground off to an angle of 45°. A well-worn old ivory-handled one, cut short and ground up is best; then, with the square laid upon the work, draw this heavily and steadily from end to end perpendicularly; next, take a side cut at about an angle of 45°, knock out the cuttings, and then you have a fair field for your tenon saw, and the "best possible way of making a close joint." But remember that when you purchase a square (so-called), if you plane up carefully the edge of a board, and try it by scribing a line and then reversing, few squares as purchased will stand the test, and must be adjusted. Memo.: I would not use a smoothing-plane after a trying-plane, unless there were hollow places which I did not care to reduce the whole surface in order to get smooth and level with the long one.

Finally, my brethren, I find that wire nails are most useful, seldom needing any preliminary bradawl boring, and if wetted when driving, in a short time will hold on even to the loss of their heads.

A., Liverpool.

ELECTRIC ELEMENTS.

[22000.]—MR. SUTCLIFFE, in his last letter on this subject (21981), refers me to Mr. Crookes' experiments as proving that negative electricity is an active state, and that positive is not. All I can say is, authorities do not regard them as proving any such thing. They are simply considered as belonging to one of the few classes of experiments which prove that there is really a difference between the two states. They do not prove that one of these states must be negative and the other positive.

Moreover, if Ohm's laws *assume* for convenience that the passing of electricity through a conducting body is similar to the passing of heat, they do not prove it. And with regard to this point I should refer Mr. Sutcliffe to Maxwell's valuable "Mathematical Treatise on Electricity," where (Vol. I., p. 36), after mentioning certain experimental facts which prove that in some respects electricity obeys different laws to either heat or energy in general, he concludes:—"It is impossible, therefore, that electricity and energy should be quantities of the same category, for electricity is only one of the factors of energy, the other factor being "potential."

Voltameter.

ELECTRIC LAUNCHES.

[22001.]—I AM of Mr. Conry's opinion, that a good motor is a necessary element of success in electrical navigation; but I cannot agree with him that there are no such motors in the market. I have tested one which gave 85 per cent. on the Prony brake when driven by my battery.

I think that the principal cause of failure is that the battery so seldom suits the motor, nor does the propeller suit that or the boat; but where these are proportioned to each other, there will be no objections to either battery or motor. My own boat, 21ft. long, now being fitted up, is driven by my primary battery, and I hope shortly to give the results of the trial trip to the readers of "Ours" in full.

E. D. Goold.

[22002.]—MY reason for introducing this subject to your readers, and dragging Mr. Toynbee's letters into a wider publicity, was the belief that many owners of launches will be glad to give up the dirty and (pace the engineers) rather dangerous steam-engines. Launches used for pleasure purposes on the upper reaches of the Thames might with great advantage be driven by electric engines, and they would certainly be preferred by ladies. I am afraid that there is not much hope of the accumulator helping to solve the problem, for it must be remembered that it can only do so by having stations where the cells can be changed—no one would wait while his battery of accumulators was being charged—and the trouble and cost would be too much. Mr. Walker, I see, says it would be impossible to go from Sheerness to Oxford and back in an electrical launch worked by accumulators. I should be inclined to say that it is impossible to go even from London-bridge to Sheerness without exhausting any accumulator battery that a launch could carry. The nitric acid battery is, I suppose, unquestionably the best arrangement to use, and as to the fumes, I think there need be little difficulty, as the cells can be in a locker, which will discharge the fumes into the water. Mr. Sprague's table gives ·0981d. per equivolt as the cost of the nitric acid battery (an equivolt being 4,673 foot-pounds); but about twice that must be allowed, to make up for losses in the battery and the motor, the screw, however, being possibly not so wasteful as with the steam-engine. Perhaps our friend, "Sigma," will "transfer his thoughts" to this subject when he can spare time, and let a little light into it. At present I cannot see but that a primary battery would be very expensive.

Nun. Dor.

STEAM SQUIRT CONDENSER.

[22003.]—IF Mr. John Henderson (21916) will consider the matter, he will see that in order to make the squirt revolve by means of the escape of the steam, the orifices must be small to obtain the necessary velocity in the jets; this would entail back pressure on the piston, and retard the engine to a greater extent than the jets could possibly help it. The loss of friction in the pipes must also not be forgotten. What would practically take place would be, that the engine would drive the squirt through the medium of the bevel wheels, instead of the squirt assisting to drive the engine, and that in addition to this loss of power there would be the above-mentioned increase of back-pressure on the piston.

A. A. Myall.

BICYCLE MAKING.—I

[22004.]—BEFORE proceeding to describe the making of a bicycle, perhaps a short explanation of why I write these papers may not be out of place.

I am an amateur, and I write for amateurs; so if a tradesman should happen to read these papers, and should see anything described that would not be practical in a regular business shop, I hope he will not laugh, but remember this disclaimer. My methods are the results of personal experience, as I have made six machines of different patterns for myself and friends, on one of which a friend to whom I presented it won over £60 worth of prizes, one of which was worth £15, and none less than £5, and preferred it to one he had costing £22.

I cannot help noticing the reluctance makers seem to evince to giving any information through these columns on the *modes of manufacture* in answer to queries, although quite ready to avail themselves of the Editor's kindness to give publicity to improvements, &c., in new machines. I have no sympathy with this sort of trade secretism, and always do my best to defeat it wherever I meet it. Now having given my reasons, and had my grumble, I will proceed to business.

It is necessary, to make a bicycle, to have the following tools:—A lathe of 3 to 4in. centre, a vice to take about 3in., the heavier the better. Of course, the lathe must be capable of turning iron, the mandrel of which should go through the entire head and project beyond collar at back, and the poppet on back head centre should be driven by a screw for drilling a firm bench and something rather heavy to hammer on; also, a pair of large hand bellows if the amateur does not possess a forge. Perhaps some may laugh at the idea of using a hand bellows in bicycle making; but let me tell them, before I made my portable forge, I found a pair of 15in. and the kitchen fire a great assistance (no pun intended). The hand tools and some special tools (to make which I will give directions) I shall mention as we come to them.

The thing to consider now is where to get the parts, and to one who has not got a bicycle to refer to, what parts are required. The latter is easier to answer than the former; but I would strongly advise the intending maker to have nothing to do with small local manufacturers, for they will charge 40 per cent. more than he can get the same goods from the wholesale firms, carriage included; and if he complains, pitch up some good tale or other about carriage, freight, superior goods, makers mentioned being trash, &c. Now all this is humbug, as none of these men make their own parts, or but few of them, and those the amateur can make himself. Perhaps, as the firm I am about to mention advertises in "ours," I may be allowed to name the one I bought most of my parts of, that is Hughes and Co., Temple-street, Wolverhampton. I merely mention them because they served me and I had no fault to find; but, doubtless, there are others as good, but in finding them one runs the risk of falling over one of the queer sort. I have no interest in advising this firm, as I doubt if they would even allow me to go over their works and see the making of said parts. Before ordering, a list (priced) should be sent for.

I will now give a list of the parts necessary to buy to make a bicycle:—One ball Stanley head; if lathe will turn 1⅛in. diameter, buying rough will save cost, and I should advise so to do. I think this form of head is about the best, but, of course, others can use their opinion. One pair hollow-welded forks; these I strongly advise, they being more rigid, and so keeping bearings parallel—a point of importance when riding, also giving less to the strain between the handles and pedals, and so being less tiring to rider's arms.

One pair front bearings: now these may be simple or compound. Simple bearings are of several forms; but the most popular are the coned cotter, and also the "Wolverhampton" coned. Compound are of so many sorts it would take half the one number of the MECHANIC to describe them all, and would be outside my purpose. They may be classed under two heads, ball bearings and roller bearings, which latter are the older form. If the amateur wishes to have compound bearings, I should advise the "Æolus," a form of ball bearing. They run lighter than simple coned, and (which to my thinking, is of more importance) are nearly dust proof; but still coned bearings run nearly as light, and wear, with care, a long time. They do not cost nearly as much; in fact, may be made with hand-turning tools, the method of doing which I will presently describe.

One pair solid cranks. Now, in these there is a point much discussed. What is the best length for these? Now, if any one takes notice, he will find that most riders use the pedal at the lowest end of the crank. This would seem to indicate a long crank being the best; of course there is a limit to this. I have found a crank of 7in. fron outside end to end, with a slot to adjust pedal, is easiest to drive, as it does not need heavy treading nor lifting the leg too high.

Two pairs pedal plates. One set ribbed pedal rubbers. Three rough pedal centres. It is best to have more than required, as they are sometimes faulty, and it saves trouble and postage stamps.

Two rough coned pins, steel. I advise steel, as they wear longer and run lighter. Some may say, Why not make ball pedals? I reply, They are a lot of trouble to make, and are but very little lighter running, and if coned are made properly they are just as good.

Two outside pedal cones.

Nipples. Now the number of these will depend on size of machine intended to be made, the rule being in nipple wheels one spoke to the inch diameter of wheel. Say wheel is 52in., that would take 52 spokes, 26 on each side of hub. It is best to have a few more than are in wheel, as one or two may break in truing up wheel. In ordering state for front wheel; lock nuts to match.

Nipples for back wheels. Back wheels are made about 16in. diameter, and before-said rules apply here also; spokes to fit nipples. State length required, and see they fit nipples well, as this adds to rigidity. I have had them a little larger than nipple hole, and carefully made a bush bit exactly size of spoke and bored nipple to fit truly. I have mentioned, as I think, they are far more satisfactory than spokes screwed in to hub, or direct-action as they are called, and for these reasons (I speak from experience): In building wheel one cannot get as great a strain on spokes, so causes a loss of rigidity. If one breaks, it is a job to get piece left in hub out. Spokes made this way are more liable to break on account of their being weakened by cutting screw just where they are wanted to be strongest, and, lastly, they are more trouble to make.

One pair crescent rims. Mention size required. This shape holds the rubber tires better than the V-shape, and is a little lighter, the V being, as far I know, only used in cheap "Brumagem cast-iron sudden deaths."

One pair rubber tires to fit rims, and see they *do* fit, as if they do not they are always getting loose. If too large and if too small, a cut gapes open, so they should be a little smaller than the rim, but not much—say, an inch in loop, but in its own diameter. It should be as near as possible, but certainly not larger than section of rim.

Beam or back bone, with neck and forks brazed in. I say brazed, as I have seen several break off, when welded just at joint, which is most dangerous. This is through being burnt or over-heated in welding, and as brazing does not need so high a degree of heat there is no risk of this happening. The beam generally needs a little bending to fit properly after machine is together. This I will give directions for at the proper time. The larger the beam is, the better it looks. One spring-curled eye—rough, of course. Any pattern may be used that is fancied, but these I have found as good as needful.

One rough back hub. I strongly advise this in rough, and don't be put off with malleable cast, which is to be told from stamped iron by the marks of the sand on skin. I think iron is preferable to red metals, for this reason: the nipple hole threads stand the strain so much better, never stripping out—a fault red metal is prone to. Why I recommend this to be made is—one can depend that the holes are drilled at the proper angle to suit diameter of wheel, a matter of some importance, and also are sure the nipples fit well, and the threads are good in nipple holes, which is not always the case with shop-finished hubs. 1. Rough spoon brake. There are many kinds of brakes, but I don't know any much better, take it all round, than the spoon; back wheel brakes, for many reasons, are not to be advised. I strongly advise all riders against riding without a brake, as dangerous to themselves and others. Some bicyclists I have known have made it a boast "their legs were *their* brake." This is folly, as a moment's thought will show anyone can go much farther with the same exertion, as the rest to the legs going down hill gives strength to go faster up the next, and if a man has but a limited time to ride, and wants to get as much exertion in it as possible, why he is not obliged to use his brake because he has one. I may mention, by the way, the remark I heard a man make who was himself one of the longest-distance riders of the world: "I hate to get into a piece of road that is one long level stretch, as I always get more tired there than where there is here and there a hill. I suppose using the brake the other side rests one somewhat."

If back-wheel hub is to be made with cones, two cones will be required. One of these should not be tapped, and do not order coned pin, for reasons to be explained further on.

1lb. rubber cement to put on tires; one pair handles—the sort I must leave to taste.

Bell, lamp, or alarm and oil-can, I must leave to buyer's consideration, merely making this remark: these things are cheaper at wholesale houses, and I have found Harrison's double alarm, and the King of the Road lamp very good. 1 saddle. Now of all I have seen or used, I think none come up to the simple suspension, as it does not gall one's sit-upon, a bad fault with most others. I do not advise the so-called ventilated or webbed-seated suspension, as cutting the iron plate for webbing weakens the saddle just where it wants to be strongest, and the ventilation gained is—Ahem.

I have omitted, purposely, a front-wheel hub, as I think this is better made by a smith on a plan I shall presently describe, the object being to get iron flanges with a *tool* steel centre-pin or axle, the advantages of which I will give; also handle bars, as these are best hand-hammered by a smith under direction. **Ixion.**

REFLECTION OF LIGHT.

[22005.]—Professor Tyndall is, of course, strictly correct when he says that the light falling upon a body is divided into *two* portions. What "L. S." (letter 21976) calls regular reflection and surface scattering in all directions, are merely different degrees of the same thing. Each case is one of true reflection in which the law of sines holds.

Surface-scattering is due to irregularities of surface, which cause the incident light to fall at every angle, and consequently to be reflected in every direction.

Partial absorption and re-emission is an entirely different thing, and it is this entirely that gives to bodies their colour. In the quoted case of the moon, if she were covered with the blackest velvet, she would actually appear *whiter* than she does now, because, in the case of black velvet, very little if any light is re-emitted after being absorbed, and the light that we receive from it is almost all reflected light, which is the same colour as the incident light.

"L. S." will remember that black really means absence of colour. If the moon were covered with red flannel, she would certainly appear red, since here would be a clear case of absorption and re-emission. **Nabla.**

LIFE AND MATTER.

[22006.]—"E. F. H.," in letter 21961, disjoints two sentences of my letter 21934, and is then astonished at my calm assumption of knowledge. If "E. F. H." intends to criticise, I must ask him to do so in a fair way. My letter was written to Mr. Grey, who, as I take it from his writings, does not admit of the existence of any other forces or conditions of matter than those we can produce and control in the chemical laboratory. It was to avoid the trite repetitions of arguments purely physical that the above sentences were written. I do not assume knowledge. My letter was written against such assumption, and as "E. F. H." is not slow in placing himself within the ranks of scientific men, it is only proper that he should act like one, and judge my letter on its whole merit. "E. F. H." calls the amœba an animal, because it inhales oxygen and exhales carbonic dioxide. As a chemist and physiologist, "E. F. H." knows, no doubt, that all fungi inhale O and exhale CO_2, which is quite in conformity with the part they play in Nature's laboratory as disintegrators of dead organic matter. But I doubt if "E. F. H." would call a fungus an animal. **Anglo-Dane.**

MATTER AND THOUGHT—MESMERIC TRANCES.

[22007.]—I may now put a further question to "F.R.A.S." in reference to what he has himself seen (21953, p. 171). Can he imagine "a lad" holding out "a pretty heavy chair at arm's length" for a considerable time without manifesting distress or *exhibiting in his attitudes the muscular tension* necessary to the result? Now that is just what occurs, as "F.R.A.S." will no doubt remember if he can fully recall the circumstances. The body is simply placed in an attitude to avoid falling, and then retains the weight much as a statue would. In what way is it conceivable that such a phenomenon could be partly the result of training and partly subjective? The most trained athletes show by their strained and quivering muscles and the expression of their faces the strain they are put to in such cases. But I have seen people doing this very thing and calmly singing a song at the same time. These suggestions are really more incomprehensible than the truth of the circumstances.

In reply to "F. W. H.," 21960, p. 175, I cannot support or accept his electrical analogies. In reply *to his question, mere matter* does certainly *not* produce a force when I set up a galvanic battery, so I do not call such a force "an entity working with the elements." The battery simply directs pre-existing forces, and re-distributes energy; like the steam-engine, it *produces* nothing. A piece of wire does *not* reproduce the human voice 1,000 miles away; the voice sets up molecular vibrations or motions in the wire, which produce magnetic changes, and these again set up undulations in the air which are similar in character to those produced by the first voice.

I can assent to what he says of the action of "living brain," while thus denying its analogy to a galvanic battery; but then he means his living brain, the mere matter and energy, and I mean by it these *plus* "life." He says, "I understand electricity." I say I do not; I know something of some of the effects we attribute to that agent or action, and my knowledge leads me to receive with much doubt the statements of physiologists; especially, I doubt Büchner's statement that "Electric currents surround the nerves when at rest," and diminish when the nerve is excited. I believe less and less in the electrical actions in living bodies, except as merely local *consequences* and attendants of the chemical and mechanical actions going on. All the parts are fairly good conductors, and I do not see how efficient or work-performing currents are to be transmitted. I am inclined to believe that the vital electric actions are purely *local*, and that the currents obtained in experiments are actually called into existence by the conditions of the experiments themselves. Nerves do conduct some action, and I do not believe they *generate* a force, as Büchner says; the brain is the generator, and also those sub-brains, the nervous ganglia; but the pure nerves appear to be connections rather than sources. But that is a subject I do not mean to be led away into discussing.

"W. A. L." (21962, p. 173), speaks of the difference in the validity of my arguments in the early part of this discussion, and this latter part, and appears to think that is a discovery. What would he have of me? He says, at first, "I dealt only with facts, and held opinions as utterly valueless." Of course I did. I was then dealing with a question of mere fact: Did mind act on mind independent of the organs of sense? Mere *à priori* opinions as to the probability of this were utterly valueless in presence of evidence of the actual occurrence. The only thing to do was to examine the evidence, and as I knew absolutely the facts, of course I could speak decisively. But now we are not in the domain of facts, but of the causes of the facts—the nature of the agents. *We have only opinions to discuss*, and deductions to draw from very limited knowledge.

True, I did define science as "what is to be *known*," and as we have now to deal not with knowledge, but with beliefs and opinions, of course I treat them very differently from facts. I have not spoken of the "extra-material principle as a truth and a fact." On the pages referred to I find that I said, "I carefully left open the question whether there is in man an inner spiritual agent distinct from the material organs," and further on, "No man knows what the nervous agent is." What I did say was that "facts strongly support *the belief* in an agent distinct from the bodily organs though operating through them." Furthermore, notwithstanding the reference to my stating it is "a fact," p. 66, there is no word of the kind there. All that I said about facts was to protest against the making of mere opinions of Moleschott and Büchner into *facts*, and then setting up these pretended facts as reasons against examining the *real facts* of thought transfer. What I have said is that, *assuming the existence of the extra-material essence*, it must needs be out of the range of science, which is limited to matter and energy—to physics, but by its nature belongs to the province of *thought and belief*, to metaphysics as distinguished from physics.

I do not like going over my past writings and contradicting false deductions; but it is inevitable in such widespread discussions, and if I allowed to pass the inductions of "W. A. L.," in which he tries to make me say things I do not say, and then winds up by putting me among those who "talk about what they know nothing about, and assert as a fact what is nothing but a notion," someone else would proclaim directly that he had proved this, and I could not deny it.

It is impossible to write in armour and test each word as if it were a poison one was tracing; so once for all let me say that whatever particular words may be tortured into, that, as I have said "no man knows," so I do not pretend to *know* anything about the nature of life and thought; but I consider that, taking into account the opinions of the wisest of men through all the ages, and the actual evidence which is attainable, I feel justified in the *belief* in an entity distinct from matter capable of separate existence, but acting in a material world only through matter; that entity, as the cause or agent of life and thought, I call "spirit" without the smallest pretence to understanding its nature. Furthermore, I think that "to hold an *opinion* about what is unknown and unknowable is (not) ridiculous," but to assert a *knowledge* is so. We hold opinions about very many things that we see either in themselves or in their effects, but of the actual nature of which we know nothing. If we entertained thoughts and opinions only about what we *know*, we should not take much mental exercise.

As to Mr. Morrison's interesting case of prolonged sleep (21966, p. 174,) I do not quite understand what he wishes to impress on us. But I do know this much, that had the patient been a nun in a Spanish or Belgian convent she would have become an "ecstatic," have seen and talked to the Virgin Mary or some saint, very likely have been marked with the "stigmata" and possible taken to bleeding at the marks on Friday. What I do not understand is the distinction between "*natural* trance, usually called *deep mesmeric sleep*." We all know (that is, all sensible mesmerists) that the mesmeric sleep is nothing supernatural—it is a natural state which often occurs spontaneously, and which can be brought about by the external mental influence; in the natural trance, and still more in the artificial one, phenomena are witnessed, powers exercised greatly different from the ordinary ones, and these indicate a mode of perception independent of the usual bodily organs of the senses. I have a very strong conviction that a powerful mesmerist would easily arouse the patient out of that sleep.

I know what has occurred to myself, and I think I have mentioned it before in these pages. I was living in lodgings in a small country town, and coming home to dinner in the evening I found the house in commotion, and that the servant was lying like a corpse on the kitchen hearthrug. She had been there for hours, and doctors had vainly tried to do anything with her; in fact she was in a regular cataleptic trance. I went down, took hold of her hands, looked at her a few minutes, and then said "Get up." Five minutes after she was laying my table for dinner. Of course, it was nothing but *imagination* on her part! **Sigma.**

CONCERNING A HYACINTH BULB.

[22008.]—I am well aware that there is not an exact parallel between the attribute of sweetness in sugar and the phenomena of life in a hyacinth bulb. The point I wished to establish was that, as we cannot *explain* the simple attribute of sweetness in terms of the formula of sugar, any more than we can explain the phenomena of life, we are not acting logically in assuming an extra-material principle in the latter case, and not in the former. If we cannot explain the simpler case, "sweetness," much less is it likely that we can elucidate the more complex case "life"; but "Sigma," and the school to which he belongs, and which he has so ably represented in this discussion, quite admit that sweetness is an attribute of $C_{12}H_{22}O_{11}$, although they cannot explain how; while, when the phenomena of life are in question, they at once assert that matter cannot possibly give rise thereto, and invent an extra-material principle to account (?) for the same. This is treating the two cases differently without due grounds, and, moreover, if by belief in the said principle the phenomena of life were really explained, or even rendered more comprehensible, there would be good argument for its existence; but the assumed principle does not in reality explain anything; nay, it only makes the mystery of the bulb yet more mysterious. We know, dimly and darkly it may be, but still we know the wonderful things matter can do. We see four elements forming almost countless compounds; we study the structure of these, and notice that a difference in arrangement of atoms in a molecule produces the greatest differences in physical attributes and chemical properties. Take, for instance, the fragrant acetate of ethyl, and the intolerably nauseous butyric acid. (I might fill a column with similar examples.) All this we know happens, but its explanation in terms of matter eludes us, and it is, I maintain, illogical and unscientific in the highest degree to limit arbitrarily the powers and forces of which we know so little. Of course all this implies a change in our conception of matter, and such change is in progress; only very ignorant persons speak contemptuously of "mere matter" now; our views are broadening, and as our knowledge grows, we are learning to regard as wonderful beyond our powers of expression "the mysterious thing called matter." "Sigma" will, perhaps, pardon me for saying frankly that I do not consider the opinions of "all the sages of past time" worthy of the slightest regard in relation to a question of modern science. It may fairly be conceded that in artistic work, in painting and music, the old masters were our superiors. No modern paintings have the charm of the old ones; and all our modern musicians rolled into one could not write the works which have rendered Mozart, Beethoven, and Handel immortal. But as far as science is concerned, the very reverse is the case; and this "Sigma" knows as well as I do. The "Sages" (capital letter, please), thought that Nature abhorred a vacuum; that the earth was the fixed centre of the universe; that a ten-pound weight fell ten times as fast as a one-pound weight;

that there were four elements; that combustion was due to phlogiston; that a magnet had a soul. Does "Sigma" believe all this? and if not, why does he quote the "Sages"? The mere opinion of such men as Haeckel and Büchner, on such a subject as the nature of life, is of more importance than all the ideas of the "Sages." "Sigma" says "nothing is more certain than the break of continuity in nature where life is superadded to matter"; I demur, and think any theorem in Euclid is much more certain. There are very few distinct lines of demarcation in nature, and it is not at all certain that one exists here. I also think it *is* unreasonable to assume that life appeared on the earth a new agent, "not matter, nor actions of matter, but operating on matter"; and call on "Sigma" for proof.

The astonishment of "Anglo-Dane" on reading my last letter can only be explained on the assumption that he knows nothing of recent views in natural science, and this explanation is strengthened by reading the remainder of his letter. He says he "is fully aware of what forces are in operation during the growth of a cell." Perhaps he will be kind enough to send us an account of the said forces; and we may be able to obtain the differential equations of the dynamics of a cell. We would probably not be able to integrate them; but I am sure our mathematical correspondents would like to try. My statement that life is apparently volatile, was not meant as a joke. If you boil a hyacinth-bulb it loses life, and if life be an extra-material principle, it is evidently volatile at 100° C. It is also volatile at zero. In conclusion, I do not expect to change "Sigma's" views, and he will scarcely succeed in his endeavour to drag me backwards to the scientific opinions of our grandmothers; but I hope the discussion may cause our readers to ponder over the great problems involved; and to look more thoughtfully at the hyacinths they will see during winter and spring.

Elswick Science School. **Wm. John Grey.**

SIZES OF BRIGHT ROUND STEEL WIRE IN FOOT LENGTHS.

[22009.]—In the watch and clockmakers' tool dealers' lists, bright round steel wire, in foot lengths, under Stub's wire gauge numbers, at various prices per lb.; thus, all sizes to No. 15 are 2s. per lb.; 69 to 70, are 11s. per lb.

It would be very useful to amateurs and others who live at a distance to have a tabular statement of the weight in grains of each one-foot length from the largest to the smallest size. I presume the sizes range from 1 to 70 of the small gauge, and from A to Z of the letter, or large gauge.

Similar information as regards hand-hammered or forged steel, square flat or half flat, which appears in these lists under numbers 1 to 17, at prices varying from 1s. 8d. to 6s. per lb., would be equally useful. Such wire and rectangular steel would be very useful in making drills and other tools; and now that we have the Parcel Post up to 7lb., if the exact weight of each size was given in a tabular form, amateurs would know what to write for, and could make up a selection of useful tools and material.

I would suggest that someone who has access to such a stock should publish a table in the following form. Such a table would have a commercial value, and be worthy of a place in Molesworth's "Engineers' Handbook," or in Calvert's "Almanac"; and its value would be increased by having the diameter of each stated in decimals of an inch.

Large Gauge: A to Z.			Small Gauge: 1 to 25.			Small Gauge: 26 to 50.			Small Gauge: 51 to 70.		
Size	Weight in grains of each length.	No. of lengths in 1lb. avoir.	Size	Weight in grains of each length.	No. of lengths in 1lb. avoir.	Size	Weight in grains of each length.	No. of lengths in 1lb. avoir.	Size	Weight in grains of each length.	No. of lengths in 1lb. avoir.
A	..	..	1	..	..	26	..	..	51	..	..
B	..	..	2	..	..	27	..	..	52	..	..
C	..	..	3	..	..	28	..	..	53	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
Z	..	..	25	..	..	50	..	..	70	..	..

G. A.

A MARVELLOUS FIREWORK.

[22010.]—As the Fifth of November is upon us, many will, no doubt, be wasting their time with gunpowder to the imminent risk of their own fingers and their neighbours' property. Any suggestion, therefore, which may enable persons to turn a few drachms of powder to the best advantage, though hardly of value, may, nevertheless, possess a certain interest.

Go to a bonnet shop and buy a small bundle of straws for fourpence. These will be found to have a length of about 10in., and to be smooth and clear. Close one end of each with a small drop of sealing-wax. Fill them to the brim with common sporting powder and drop a piece of touch-paper loosely over the mouth of each. All of these are rockets of surprising power.

Lay one at a time in a trough of paper about a foot long, fitted to any desired angle, and light the touch-paper. The straw will start away with amazing velocity, and may well clear the houses on the opposite side of the street, or go in at their open windows. If one of these rockets strikes a piece of soft wood near the end of its flight the tremendous force with which it travels is well shown, for the straw penetrates the wood, cutting a clean sharp ring upon it, and is itself split like glass; moreover, all the gunpowder still unburnt explodes with a sharp report. If a lead shot be stuck to the sealing-wax at the top and covered with an ordinary gun cap, the rocket becomes a detonating apparatus when it strikes a wall on the opposite side of the road.

It is impossible to tell precisely in what direction these rockets will fly. The difficulty is at the start, for having once started they go well enough. A clean glass tube a foot long and three-eighths of an inch bore is in this respect superior to a trough. It is worthy of remark that perfectly straight straw will not fly well, whereas a curved one, in consequence of a spinning action which seems to be set up, flies almost perfectly true. When, however, absolute precision is desired, it is best to make a line rocket of the straw. For this purpose take at least fifty yards of fine iron wire and stretch it between two fixed points; twist two pieces of very fine copper wire around the straw, one very near the closed end and the other about 3in. off; bend the free ends loosely over the line wire, so that the straw hangs parallel to it and is quite free to move. This is an entertaining firework which may be let off safely in a long corridor. If one of these is observed from near the finishing end some idea may be gathered of the fearful rapidity with which they travel. They may be made to spin as they go by hanging them at an angle.

These straw rockets, though insignificant in comparison with those of the usual sort, nevertheless, from the ease with which they are made and their perfect safety, very well repay anyone who will take the trouble to try them. **Old Moss.**

TO MR. ALLEN—ALBUMINOIDS OF MILK—LIQUIDS IMMISCIBLE WITH OIL—CHEMICAL—AMMONIUM SALTS—CALCIUM SULPHIDE—NAPHTHOLS—ANILINE.

[22011.]—In answer to query No. 52005, page 161, headed "To Mr. Allen," the albuminoids of milk are not habitually isolated in milk-analysis. For ordinary purposes it suffices to determine the ash, the fat, and the "solids not fat," which, of course, consist chiefly of the albuminoids and milk-sugar. I do not know what particular method the querist refers to as that in which "use is made of a funnel and cooler." The best method of determining the albuminoids of milk is to dry up a known weight of the sample, extract the fat with ether, treat the residue with absolute alcohol, and then exhaust it [illegible] insoluble [illegible] portion in the [illegible] milk, [illegible] which [illegible] the one to which the querist alludes. If he will explain his meaning a little more fully, I will try to assist him.

"Liquids immiscible with oil" (query 52058, page 162) are to be found in common brine and all saline solutions. Syrup and acids also satisfy the conditions of the query.

In reply to unanswered query, No. 51622, page 45, headed "Chemical," the bisulphate of ammonia can be readily prepared by dividing a quantity of sulphuric acid into two equal parts, saturating one with ammonium carbonate (using litmus paper as the indicator of neutrality) and adding the other portion. The salt will crystallise from a very strong solution. An alternative method is to add three parts by weight of oil of vitriol to a strong solution of four parts of commercial sulphate of ammonia.

The "bisulphite of ammonia" is best obtained by saturating a solution of the commercial carbonate with the gas evolved on heating sulphuric acid with wood charcoal. The composition of the product is somewhat uncertain.

The "hyposulphite of ammonia" is best obtained by precipitating a solution of the calcium salt with one of carbonate of ammonia, filtering and concentrating the filtrate.

The "conversion of calcium sulphide" (unanswered query No. 51650, page 46) into the hyposulphite readily occurs by blowing air through the moist substance. On lixiviating with water, a solution is obtained which may be further oxidised, if necessary, by treatment with air, avoiding a high temperature. The complete conversion of the sulphide is indicated by the solution giving no precipitate with zinc or manganese sulphate. Considerable formation of the sparingly-soluble sulphate and sulphite of calcium occurs at the same time with that of the hyposulphite, which is very readily soluble.

"A and B-naphthols" (unanswered query, No. 51651, page 46) are both colourless, crystalline substances, easily soluble in alcohol, ether, chloroform, or benzene, but sparingly soluble in hot water, and almost insoluble in cold water. A-naphthol crystallises from water in small needles; B-naphthol in laminæ. The former melts at about 95° C., boils at 278° to 280°, and has a faint odour like that of phenol. The latter body melts at 123° C., boils at 285° to 290°, and is almost odourless. A-naphthol readily volatilises with the vapour of water; the B-compound only very slightly. The aqueous solution of the A-compound becomes dark violet on adding bleaching-powder solution; and red, passing to violet, on addition of ferric chloride. The solution of B-naphthol is coloured pale yellow by bleaching-powder solution, and pale green by ferric chloride.

I don't see why the potassium sulpho-naphthalene salt should be preferable to the sodium compound. There may be some practical advantage. At the end of the reaction, the fused mass is dissolved in water, the filtered solution mixed with hydrochloric acid, and the separated naphthol recrystallised from water and purified by sublimation.

"Aniline" (unanswered query No. 51652, page 46) is now manufactured by distilling nitrobenzene with hydrochloric acid and iron filings, when the following reaction takes place: — $4C_6H_5NO_2 + 9Fe + 4H_2O = 3Fe_3O_4 + 4C_6H_5NH_2$. My impression is, that the advantage possessed by hydrochloric acid over acetic acid is that, while an excess of the latter led to a formation of acetanilide, with the former there is no tendency to a loss from a similar cause. I am not certain, however, that this is the true explanation. Of course, the use of a large excess of hydrochloric acid would result in the formation of the hydrochlorate of aniline.

Sheffield, Oct. 27. **Alfred H. Allen.**

M. J. R. Bourguignat continues and completes in the *Annales des Sciences Naturelles*, tome xv., his valuable memoir on the "Malacologie de l'Abyssinie." The Messrs. Milne-Edwards have devoted the entire number of the *Annales* to this paper, which is well illustrated by plates of the mollusca of Abyssinia and a "Carte Malaco-Stratigraphique de l'Afrique."

Some notes on verification of the atomic weights of zinc and magnesium have been contributed to the *Archives of the Physical and Natural Sciences*, Geneva, by M. C. Marignac. The atomic weight of zinc, fixed by Erdmann at 65·05 and by Favre and Jacquelain raised to 66, is approximately determined at 65·33, a figure which further analysis may show to be slightly too low. For magnesium, calculated by MM. Marchand and Scheerer at 24, and by others at 24·5, the number of 24·37 results from the author's fresh experiments.

[illegible] is proposed to establish a permanent industrial [illegible] on the banks of the Hudson, within [illegible] of Central Park, New York city. [illegible] company has been formed with [illegible]

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51251.]—**Sulphuretted Hydrogen (U.Q.)**—The querist asked for information as to making sulphuretted hydrogen, and he is told by Mr. W. E. Haden, on p. 155, to act upon FeS by H_2SO_4. I should imagine if he can read the formulæ given, that it would have been unnecessary for him to ask how to make the gas. He is also told that he can do away with the offensive odour by burning the H_2S (to insure which he would require a good pressure of gas, and a specially constructed precipitating apparatus) to SO_2 and H_2O, or by mixing with chlorine from hydrochloric acid and potassic permanganate. Mr. Haden does not inform "Zelia Naien" how he is to mix the gases, or in what volume to mix them, to insure perfect decomposition of the H_2S. If Mr. Haden has ever worked in an analytical laboratory he will know very well that such a process to do away with the odour, however correct in theory, requires in practice what no student would attempt to put in operation. The cure would be "worse" than the disease, to use a common phrase. If "Zelia Naien" requires sulphuretted hydrogen for manufacturing purposes, his best material, or the cheapest, would be alkali waste, which yields a copious supply of H_2S when treated with sulphuric acid. The waste he can obtain from any alkali works by paying the carriage, as the alkali makers are only too glad to pay for removal in many instances. If his neighbours complained about the odour arising from the escape of any of the gas, he might precipitate in a covered vat, connected to a furnace by an exhaust pipe terminating in a perforated coil, so as to insure perfect combustion of the excess of gas.—PRACTICAL CHEMIST.

[51253.]—**New Zealand.**—To those who may feel inclined to adopt the advice of Wm. H. C., and take the handbook of Mr. Berry as a guide, I commend the following extract from *The Auckland Evening Star*, one of the leading papers of the North Island. "An Aucklander on his Travels.—Travels in Scotland.—Glasgow is very dirty, and as I shall allude to it again, I pass on to the country, which is very similar in its features to New Zealand . . . The Rev. Mr. Berry has issued a pamphlet on New Zealand, which is, I think, altogether too glowing, and consequently has shot a little beyond the mark. It is a mistake to allow the imagination to go so far as Mr. B. has done, as it only tends to make emigrants dissatisfied when they arrive and find they have to work as hard in the colonies as they have in England." That no dispute may arise as to the truth of the above, I have inclosed the cutting to the Editor; and that it shall not be stated that the paper in which it appeared was edited by a person whose sentiments were anti-colonial, I give the following extracts from two of the leaders that appeared in it about the same date. "Monday, Nov. 22, 1880.—The dead-set made against N. Z. by *Truth*, and some other London papers, will no doubt do the country injury in the eyes of the very class which the colony desires most ardently to secure, and for which it offers *bonâ-fide* attractions. Every number of *Truth* received by the last mail contains a violent onslaught on N.Z. finance and prospects. The very smallest fact that can be turned against the colony is strained and twisted to appear to its greatest possible disadvantage. The correspondence of every anonymous scribbler, however ignorant of his subject, is set out in leaded type, and its weight and importance exaggerated. The letter of some person signed 'John Foster,' who is described as 'recently the pastor of the Congregational Church at Kirton, Bristol,' which contains the most diabolical series of groundless and unmitigated slanders on the colony ever put together in the same space, is quoted almost as a voice from heaven."—Wednesday, Jan. 26th, 1881. From a copy of the London *Globe*, which is a widely circulated evening paper with considerable influence, the following paragraph is taken:—"In a letter to the Secretary of the United Kingdom Alliance, dated September 10th, Sir William Fox, formerly Prime Minister of New Zealand, writes:—'Our colony (N.Z.) is at present in an unprecedented state of depression, even proportionately worse than any part of the old world has suffered from.' That Sir William Fox should be writing to the Secretary of the United Kingdom Alliance is exceedingly probable, though why he should thrust this gratuitous detraction of the colony into his letter does not appear. Possibly it may have served to point some moral. Be that as it may, the circumstance is sufficiently remarkable to call for an observation or two. It is a great pity that Sir William Fox did not exhibit more wisdom. He has held the next to the highest office under the Crown in N.Z. He has lately been serving on an important commission. He is a prominent supporter of the present Government, and it is not impossible that he may some day take a portfolio again. In fact, Sir William Fox is so important a figure in our politics that a statement from his pen cannot fail to have great weight and influence in England. This consideration, which is, of course, as evident to himself as to anyone else, ought surely to have been present to inspire caution when writing a letter of a semi-public character. But it seems that it was not, and the injurious report went forth at a time which may be deemed almost critical. It was when the English Press was conspiring with provoking unanimity to throw discredit upon the resources and financial capabilities of the colony; when the most dolorous accounts of the state of affairs here were being industriously circulated throughout the length and breadth of England. One would imagine that at such a juncture a N.Z. statesman, with the interests of his adopted country at heart, would either hold his peace, or, at any rate, say nothing which might produce untoward results. But whether the statement was true or not, it is clear enough that there was nothing to justify or excuse the circulation of it by such a personage at such a time." If the statements of an eminent colonial statesman, and an English Clergyman, meet with this scurrilous abuse, and the whole English nation are charged with conspiracy, &c., I think the readers of the MECHANIC will excuse any attempt upon my part to remove the dirt thrown upon—LONDON STONE.

[51421.]—**Microscopical (U.Q.)**—If the pollens are small and transparent, they should be mounted dry—*i.e.*, a thin glass cover should be cemented over them with gold size, four pieces of thin cardboard having been previously cemented round the edge of the thin glass cover, which should then be cemented over the pollen, which must have been previously placed in the middle of the slide. The slide can then be covered with an ornamental paper cover, or left plain as desired. If opaque, they should be mounted in a shallow cell in essential oil of lemon. The cell is placed under the glass cover, and cemented to the slide on one side and the cover on the other with gold size, as the paper is in the dry method. The essential oil of lemon is to be poured over the pollen, which must have been previously placed in the centre of the cell, and the glass cover is then lowered gently over it till in position. The oil which oozes over the edge of the cover during this operation must be wiped carefully up with a cloth, and a rim of gold size painted round the edge of the cover to seal it to the cell. When this is dry another layer of gold size is put on, and so on till quite secure. Glycerine may be used instead of essential oil of lemon. Petals of flowers should be mounted in the same way, using glycerine, but before immersing them in glycerine they must be soaked in alcohol to remove some of the colouring matter contained in the cells. —R. A. R. BENNETT.

[51613.]—**Knapp's Solution (U.Q.)**—As this query does not appear to have been answered I send the following extract from Miller's "Elements of Chemistry," Vol. III., p. 607, which may be of use to querist:—"Sachsse finds that Knapp's solution does not give accurate results. Knapp found that 100 parts of dextrose reduce 400 parts of mercuric cyanide, which is in the ratio of 1 molecule of the former to somewhat less than 3 of the latter . . . . but Sachsse states that the amount of cyanide reduced depends on the rate at which the dextrose is added to the boiling mercuric cyanide solution, the reduction being greater the more rapidly the titration if effected. He finds, however, that an alkaline solution of another mercuric salt—viz., the iodide—yields constant results. The solution is prepared by dissolving 18grm. pure mercuric iodide in water with the aid of 80grm. of potassic iodide, adding to this 80grm. of potassic hydrate solution in water, and diluting to 1,000 cubic centimètres. Of this solution 40c.c., containing ·72grm. of mercuric iodide, are heated to boiling in a porcelain dish, and solution of the carbo-hydrate of about half a per cent. strength is added, at first in quantities of 5c.c. at a time, then in quantities of 1c.c., and lastly by tenths of a cubic centimètre, until the whole of the mercury is precipitated, which is ascertained by means of a saturated solution of stannous chloride in alkali, a number of drops of which are placed on a porcelain plate, and one of them mixed with a drop of liquid from the dish after each addition of the carbo hydrate solution. At first a black precipitate is produced which becomes less and less evident as the reduction proceeds, and the titration, is regarded as complete when the addition of a drop of the titrated liquid no longer produces even a brown colouration. It is found in this manner that on an average ·1501grm. of dextrose is required to effect the reduction of 40c.c. of mercuric iodide solution containing ·72grm. of mercuric iodide.—R. A. R. BENNETT.

[51697.]—**Crystoleum Pictures.**—The defects complained of must be due to something in the process followed by the querist.—PHOTO. ARTIST.

[51708.]—**Restoring Ink Writing.**—It depends so much on the nature of the ink and the substance used for bleaching, that one can only venture to suggest that the querist should try washing over portions with a solution of green copperas—that is, sulphate of iron.—NUN. DOR.

[51723.]—**Oxide of Copper Battery.**—The querist ought to find an answer on p. 500 of the last volume. How many cells depends upon the kind of lamp. At a guess, I should say 30, if the lamp is of high resistance. The other questions must remain unanswered until someone has experimented.—NUN. DOR.

[51739.]—**Waterproofing Sheets.**—If only for covering the creases, use the best double boiled linseed oil, coloured with lampblack. If you really want the quantity mentioned (95 gallons), you will have no difficulty in getting it from any large oil and paint warehouse.—NUN. DOR.

[51743.]—**Staining.**—I presume you know it is done with beer or with umber and other pigments, varnishing afterwards. If I wanted to do it, I should use the ready prepared stain, sold by oilmen, and wax well after thoroughly dry. If you do not want that stain, try the effect of strong solution of potash, bichromate of potash, or permanganate of potash, on one corner first; but remember that the full effect is not brought out until light has had its effect, and the wax, polish, or varnish is added. —NUN DOR.

[51745.]—**Voice Missing.**—No one can say what is the cause of the querist losing his voice, except that it is some affection of the chords. He should be examined with the laryngoscope.—J. T. M.

[51746.]—**Weak Ankles.**—Bathing with salt and water, rubbing in hartshorn and sweet oil, &c., might help. Better than elastic stockings, because the object is to stimulate the ankle, not to artificially support it, which it will then always need. —B. W. R.

[51747.]—**Coal Saver.**—I have used a piece of flat iron placed obliquely behind the fire; but that was to reduce the space in which the coals were consumed. What querist means must, I think, be one of the many devices for heating air which is thrown into the room through passages arranged around the mantelshelf and the jambs of the fireplace.—N. E. CHILD.

[51752.]—**Tricycle Making.**—If I wanted to make one I should not make the one referred to by querist. I should get a set of fittings (often advertised in these pages) and work away at them. A front steerer with moderate-sized wheels, with double driving gear, is about as good a machine as you will find.—N. E. CHILD.

[51768.]—**Joy's Valve Gear.**—This was illustrated on a locomotive a little time ago (p. 411, last volume) and was fully described in a paper, p. 611, Vol. XXXI. If querist will look at those figures, knowing what his own engine is like, he will be able to see whether it can be altered.—ESSAR.

[51771.]—**Painting.**—I think Lockwood and Co. publish such a book, by E. A. Davidson.—NUN. DOR.

[51780.]—**Cue-tip Cement.**—"Querist" should keep his cement well corked. Is it coaguline—isinglass and acetic acid? If so, it wants standing in warm water.—NUN. DOR.

[51783.]—**White Metal.**—Will one of the alloys given on p. 134 answer? Zinc should always be melted before mixing it with copper or brass—the latter being melted first of course. If Mr. Dixon will refer to the reply p. 134, and fails to find anything suitable, I will help him if he will give some idea what the metal is for or what it is to do.—NUN. DOR.

[51798.]—**Educational.**—One way is to article the lad to a civil engineer. He might attend the classes at University or King's College. See prospectuses.—ESSAR.

[51843.]—**American Locomotives.**—"S. J." had better procure an American Railway Guide; surely he could obtain one in London. Even the shortest statement of mileage and routes of American railways would occupy far too much valuable space, and be of interest to a very few of our readers. As regards the latter part of this query, I do not think that such subjects as the financial positions of railways are intended for insertion in the "E. M."—GUIDE YOKE, U.S.A.

[51858.]—**L. and S.W.R. Locos.**—Dimensions and a sketch of the 136 class appeared in the "E. M." for April 19, 1881.—GUIDE YOKE, U.S.A.

[51858.]—**L. & S.-W. Engines.**—The 12 engines, Nos. 136—147, were built by Beyer, Peacock, and Co., in 1880. The coupled wheels are 6ft. 6in. diameter; bogie wheels, 3ft. 3in. The cylinders are 18 by 24; heating surface of firebox, 104 square feet; of tubes (234 in number, 1¾in external diameter, 10ft. long), 1,112 square feet; weight of engine, road-worthy, 47 tons.—W. B. P.

[51874.]—**Stone in Specification.**—The object of the specification is to insure the builder doing his work in a proper manner, and using proper materials. If a "bedstone" merely had been specified, he might have put in any irregular-shaped boulder, and therefore he is required to put in a "tooled" stone—i.e., dressed with the hammer and chisel. It is taken for granted that he will not "tool" it into an unsuitable shape out of "pure cussedness." It must be evident that a naturally-shaped stone would form a very bad bed for a pillar, compared with a flat "tooled" stone.—Murano.

[51899.]—**Medical Coil.**—Will "Watt" please state if his coil was as powerful in the tube as when uncovered? Also with regard to battery—1. What is the power of a ch. of silver cell compared with a bichromate of same size? 2. Instructions to make one to go into handle would much oblige, either chloride or Marie Davy, which latter seems a very fair one. Mons. A. Niaudet, in his work "Traité de la Pile Electrique," mentions one used by Gaiffe for coils, with no free liquid to sodden blotting-paper. Is this of any sufficient power for purpose?—Thor.

[51910.]—**Canadian Locos.**—With the Editor's permission I shall be glad to send a paper or two on "Modern American Loco. Practice," giving chief dimensions of remarkable types, and if desirable, a few construction notes.—Guide Yoke, U.S.A.

[Please send.—Ed.]

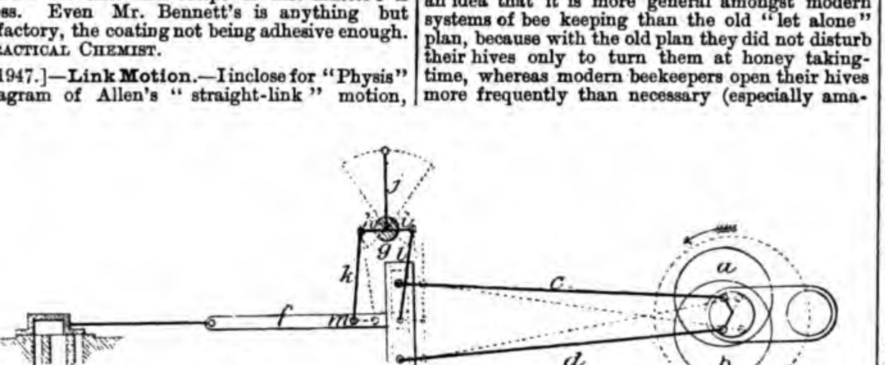
[51924.]—**Golf Balls.**—I should think a bright red paint, carefully put on the balls, would answer your purpose very well. But, in my opinion, no good will be gained by changing the colour from white to red, as the former is quite as easy, if not easier, to be seen on grass as the latter.—W. Henley Richmond.

[51930.]—**Teazles.**—There is a very interesting account of the cultivation of this plant in "The Journal of a Naturalist"—a book which used to be nearly as popular as "White's Selborne."—R. C. D.

[51939.]—**Renovating Silk Mantle.**—Benzine will probably remove it. Dip a bit of flannel in the benzine and rub the place. Lay a piece of cloth, several times double, under the place to be cleaned, so that the benzine may wash the dirt out of the mantle into the cloth. Do it at daylight, as benzine is as inflammable as gas. A teacupful will evaporate in a very short time. Benzoline will clean just as well, and is very much cheaper; but it leaves an oily residue in the fabric to which dirt sticks, and consequently looks dirty again almost directly.—Murano.

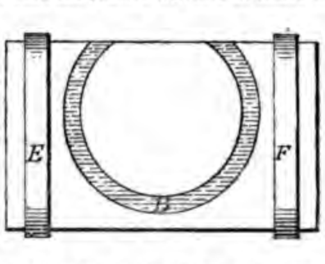
[51944.]—**Coppered Wire.**—W. Henry asks how to coat iron goods with copper. S. Austel tells him to dip in a solution of copperas. Is not this sulphate of iron? I send the Editor a sample which has been in a solution of what Mr. Austel means 51944 to use, that is sulphate of copper or blue vitriol. I also send for comparison a sample treated by Mr. Bennett's method. It does not—as the Editor will see—look very coppery. You will now see that this recipe of Mr. Austel's is useless. Even Mr. Bennett's is anything but satisfactory, the coating not being adhesive enough.—Practical Chemist.

[51947.]—**Link Motion.**—I inclose for "Physis" a diagram of Allen's "straight-link" motion,



which I hope will almost explain itself. *a b* the forward and backward eccentrics, *c d* eccentric rods, *e* expansion link, *f* valve rod link, *g* reversing shaft with arms *h i* keyed upon it, moved by a connection from the foot plate, taking hold of the extremity of the lever *j*; *k l* the two suspending links, the first attached to the valve-rod link at *m*, and the other attached to the expansion link *e*. The advantages are that the motion necessary for reversing is divided between the expansion link and the valve-rod link, so that the actual vertical motion is only half that of the ordinary forms of link motion, and the angular position of the valve-rod is consequently less, so that the strain is more direct; again, it is obvious that the parts can be made to balance one another, so that the customary heavy counterbalance weight can be dispensed with.—A. A. Myall.

[51949.]—**Zoophyte Trough.**—You can re-cement this with thick shellac varnish, with glucine, with "cement of Pompeii," or with marine glue; but there is a form of trough so simply constructed and so easily cleaned that the microscopist may be satisfied with it. Get two pieces of glass about 3in. by 2in., between them lay flat an indiarubber ring, having the upper portion cut off; bind the glasses together at either end with



an indiarubber band. E F show the indiarubber bands; B is the band laid flat between the glasses.—E. B. Fennessy.

[51951.]—**Astronomical.**—In this it is stated that there is an inequality in the longitude of Mars produced by the Earth, amounting to five minutes in two centuries. The querist asks what is the displacement of the Earth by the action of Mars in the same time. Now, if there is any such displacement of Mars there will certainly be a corresponding one for the Earth; but it will be very much larger than any which actually exists. Many years ago I was at the pains to calculate an inequality of long period (about 17 hundred years) in the place of Mars, produced by the joint action of the Earth and Jupiter, and it amounted in that time to about 45 seconds, with a corresponding one for the Earth of about 7·3 seconds. The latter was also calculated by Leverrier and Hansen, with nearly the same result, especially by M. L. There may be an inequality for Mars amounting to five seconds in 200 years; but there certainly is none such, or anything at all like it, as that spoken of by your querist.—W. G. P.

[51974.]—**Engine.**—"To Glatton."—I am sorry that I have been unable to convey to "Glatton" the proper meaning; but I will try to do so now. When the valve is in the middle of its stroke its faces fall short of covering the ports a ¼in. at each side; with this the exhaust has a 1¼in. lead, although the steam side has only ¾in. lap and ¼in. lead.—Thomas Blackburn.

[52001.—**Wheel Grease.**—The following is a recipe of a wheel grease which may possibly be of some use to "Simplex." It is, I believe, nearly similar to that used by railway companies in summer weather:—Russian tallow, about 19lb.; palm oil, about 12lb.; soda, about 1lb.; water, about 3gal.—T. M. R.

[52013.]—**Bees.**—1. It is so reported by some of the most experienced beemasters, but until recently I have not seen any cases of it; but have an idea that it is more general amongst modern systems of bee keeping than the old "let alone" plan, because with the old plan they did not disturb their hives only to turn them at honey taking-time, whereas modern beekeepers open their hives more frequently than necessary (especially amateurs) and thereby get brood chilled. I read a little time ago of one case where a new beginner said he only kept his hive open for half an hour, and was surprised that the brood got chilled. Then, again, feeding I think is at the root of many of the ills that bees are subject to, that is, feeding either at a wrong time with unsuitably prepared food or unsuitable quantity, which fills the hive with damp vapour at a time when cold weather coming on causes the bees to cluster closer and leave the outside combs uncovered, and sometimes brood is left to die and rot. Then, again, good as artificial food is, I cannot think that any food is so good for them as honey collected, stored, and sealed in their own way. The old skeppist never takes any honey out of hive (only from super at top), and, providing the hive stands on good floor board, and is well covered from rain, it has every chance to keep healthy, especially as he generally takes early swarms and leaves the stock, which, having a young queen, does well. Foul brood has a bad smell. You can only detect it by finding the bad brood and bad smell. More likely some months earlier, as few hives have brood in now, except those suffering from the plague earlier on in the year. Several bee masters have had the disease break out, and with the utmost care have only been able to save a few stocks—many having perished altogether. I should like some one who has had much experience to write, as "J." suggests; but I believe thorough cleansing of hives, spraying with dilute salicylic acid, feeding with S. acid in syrup, and other similar measures, often get rid of the disease. 2. I prefer sugar cake for winter or early spring assistance, but have not much faith in feeding at all in winter. 3. Honey and pollen, if sealed over, will keep if kept in a dry place, but not otherwise. Do as I have, and make an extractor out of large meat tins, &c. 4. The Abbot frame and hive is a little larger, and is rather narrower at bottom, to avoid crushing bees, when taking bars out or putting them in.—J. I. S.

[52019.]—**Gas-Engine.**—In reply to this query, page 182, please read Vol. LXIX. (instead of XCIX.), Session 1881—2, part 3.—R.A.

[52020.]—**Raising Lid of Iron Box.**—I should try the following: A spring made up the same way as put on doors to keep them shut, say, three, one on each end and one in the centre. Fix the spring to the side of box, and the tail end pressing against the lid.—Blacksmith.

[52031.]—**Dynamo.**—I am obliged to "Watt" and "Light" for their replies. In reply to the first-named, I had originally eight turns of wire on F.M.'s; these I reduced to four, making the R. nearly equal to A. Result: A deflection of galvanometer of 10°. Then I gradually increased the winding on both A. and F.M.'s to eight turns on former and six turns on latter, and get the best results with this, which shows the rule quoted by "Watt," that the R.'s should be equal, does not apply here. Comparing with other machines, the distance between A. and poles' clearance is not too great. In reply to "Light," I have tried all kinds of connections with the wire on F.M.'s, and in one way only can I get a current. The F.M.'s are both wound same way, and the inner end of wire on each limb of magnets coupled to brushes, and the outer ends to terminals on machine base. The magnets are secured to the cast-iron base plate, and not insulated from it. Since my query was inserted, I have managed, by winding two more turns on A. to get a little better result; but still I do not get sufficient current to light a lamp. In consequence of the interest taken in dynamo construction, I should prefer all suggestions and advice on my machine to appear in "ours." For my part, I shall have much pleasure in acknowledging the same, and giving the results of any alteration that may be suggested short of making a new machine.—Labor Omnia Vincit.

[52037.]—**Freehold Property and Building Societies.**—No question need be raised by the building society as to the person to whom they can give a release; all they have to do is to endorse a receipt upon the mortgage deed in the form prescribed by the Building Societies Act, 1874, if the society is incorporated under that Act; if the society is not incorporated, then in the form provided in its rules, and authorised by 6 & 7 Will. IV. c. 32, sec. 5. For an incorporated society there is authority (Wright v. The Monarch Building Society, L.R. 5 Ch. Div. 796, which has been confirmed in other recent cases by the Court of Appeal), that any dispute arising upon such a point as that raised in the question would have to be settled in the manner provided for the settlement of disputes by the rules of the society.—E. F. Brabrook.

[52043.]—**Induction Coil.**—To L. W. Willis.—You should make your coil 8 or 9 inches long and diameter ½in. For primary, two evenly wound layers of No. 18 cotton-covered wire, well insulated from secondary. If you use 12 or 13oz. of secondary you will be able to get a 1in. spark. Any more information, if wanted, with pleasure.—A. V. Nicholls.

[52045.]—**Checks upon Tramway Fares.**—The checking of fares is very carefully and well managed on the Liverpool tramways. Every conductor has a way-bill, which is filled up with numerals—say, from 1 to 25—and it also contains a few particulars as to time of starting, the guard's name, &c. For every passenger that enters the car one of these figures is stamped, beginning of course at No. 1. At various places during the journey, men called "checkers" examine the way-bill, and affix their stamp to the number of persons then in the car, and also to the number that were originally in. For example, if 15 persons were in the tram at starting, and six got out before the register was examined, there would be nine remaining when the checker got on the car, so that he would stamp the 9 as the present number of passengers, and 15 as the original number. The next checker would proceed in a similar manner; and as there are often three or four of these officials in a journey of about three miles, any attempt at fraud would be almost sure to be detected. But this is not the only precaution taken. Every conductor is supplied with tickets which vary in colour to represent the different fares. For instance, a buff colour for a 1d. fare, white for a 2d., pink for a 3d., and so on. The guard has also a machine for punching the tickets. As each passenger pays his fare, the conductor hands him a ticket, having first clipped a piece out of it. Now the piece so cut off falls into a receptacle in the machine, and there remains till it is taken by the proper authorities. Every ticket is numbered, so that it is very easy to tell the exact number of tickets given away and the number of fares taken. If the guard commences at No. 224 and ends at 244, there ought to be 20 of these small pieces, each of which represents so much money; so that with the checking of the way-bill and the clipping of the tickets everything is almost certain to go on in a straightforward manner. Of course, I am only alluding to one particular city in England, but it is perhaps the most important as regards tramway systems. I cannot say whether this mode of working is adopted in other English towns, or foreign ones either, and I am afraid you will not find many readers of "ours" whose knowledge of the subject is so extensive as to answer that part of the question. As to the omnibuses, the fares are almost exclusively checked by the way-bill process. A few of them have a bell or indicator which is rung every time a passenger enters; so that by looking at the number on the indicator when starting, and substracting it from the figure shown at the conclusion of the journey the number of passengers is ascertained.—W. HENLEY RICHMOND.

[52057.]—**Imitation Glass.**—If "Advertiser" will observe the following he will no doubt succeed: Size over the pasteboard with vellum size. Let this get thoroughly dry, then give it three or four coats of good white paper varnish. Let each coat get dry and somewhat hard before applying a second coat. Gelatine is hardly suitable for the purpose, but paper varnish is not much affected by the damp, and is infinitely superior to gelatine.—G. FRYER.

[52058.]—**Liquids Immiscible with Oil.**—Would treacle, or a solution of gum, tragacanth or arabic, answer? These two gums sink in water, and are, therefore, heavier. I think treacle sinks also, and would, perhaps, be heavier than dissolved gum. Or would nitric acid answer?—MURANO.

[52059.]—**Telephonic.**—In part reply to this query I may say, *re* Blake transmitters. 1. Ferrotype plate to be obtained from any photo-apparatus depot. 2. Don't know. 3. Primary about No. 30; secondary No. 36. 4. Battery named would be about the thing.—THOR.

[52062.]—**End Bearing for High-speed Spindle.**—Repolish end of spindle and leave it very slightly rounded, also polish the plug and leave it flat, then be certain that no emery or grit is left in the bearing, and fill oil-well with mercury. This has cured a similar case.—W. A. T. C. H.

[52062.]—**End Bearing for High-Speed Spindle.**—It seems to me that you have made no provision for the oil running down to bottom of footstep. You should cut a groove down and half way across the bottom. Use sperm oil, and with a cast-iron or hard gunmetal footstep, I don't think you will have any trouble.—LABOR OMNIA VINCIT.

[52063.]—**Feed Pump.**—This is one of those queries that no one can answer with any certainty without either an indicator diagram or a pressure gauge on valve-box. The pressure in a pump depends a very great deal on the resistance to the passage of the water caused by crooked passages and bends in the delivery pipe, that the pressure necessary to force the water against any given head is often very much greater than is apparently necessary. I could give you lots of cases where the pressure in pump was twice the actual pressure in the delivery pump.—LABOR OMNIA VINCIT.

[52064.]—**Exhaust.**—The following formula will enable "Pressure" to determine the distance the piston is from the end of its stroke when the exhaust begins to open:—*From* the lap and lead on one side of the exhaust subtract the lap on the other side, divide remainder by the stroke of slide, square the quotient, and multiply it by the stroke of the piston, and the product will be the distance that the piston is from the end of its stroke when the exhaust begins to open.—ENGINEER, Dewsbury.

[52068.]—**Fairy Lamps.** The fairy lamps at theatres are lighted by means of small accumulators. You will find descriptions of them in back vols.—WATT.

[52072.]—**Crayfish.**—Crayfish are to be found in most of the Midland brooks with deep holes, and a little mud. I once pulled up some basket putchins in the stream running past the waterworks at Oxford, and found them all full of crayfish.—STRETTON.

[52072.]—**Crayfish.**—Rather late in the season, I am afraid. August and September are the months to catch them. The way fully described in former numbers. I have caught them in Herts, Berks, Hants, and Wilts, in the Kennet and Avon, and in canals and small outlets from them. They can be easily propagated in any clear running stream, not too deep, with weeds at the bottom, by procuring a hundred or so and putting them in the stream, and to keep them to about the same spot by putting sheep's entrails in the stream occasionally, or any refuse of the kind. A good plan is to get a faggot and put the entrails inside, and fasten a rope to it, and put in the water, occasionally replenishing. In July the females deposit their young. I have caught them covered with young by the hundred, like you may see shrimps. If R. Enis will advertise his address, I will try and send him some at a small cost. I have never caught them in rivers where the tide ebbs and flows: perhaps salt water will not do for them. Any further information in "ours" I will gladly give. I have had them running away with my bait when fishing for trout at the bottom with a worm, much to my annoyance.—TIT SANDERS.

[52074.]—**Lathe.**—Your drawing is not complete enough to enable one to give very precise directions as to the making of the pattern and core box. A longitudinal view, as well as a section, is necessary. Simpler beds than yours appears to be are cored out, and you had better adopt the same method. I do not see why the fillet C should cause trouble—if in the top it will be fast, if in the bottom loosely wired on. ¾in. is thick enough for the bed; but if you will give a sketch longitudinally I will furnish information.—J. H.

[52075.]—**Legal.**—The wife in this case having obtained a magistrate's protection order, is in fact a feme sole, or single woman, in regard to any property which she becomes possessed of after the order is made, provided the order was entered with the registrar of the county court within ten days after the making thereof. Therefore I think "Dubius" would be perfectly safe in paying the legacy of £100 to the wife on her receipt alone, as the protection order makes her a single woman, and this whether the legacy was bequeathed before or after the date of order.—F. A. S.

[52076.]—**Paint for Tin Pots.**—I think a thick varnish, made of shellac dissolved in naphtha or methylated spirit, would answer well. I have one which I painted with this, and is used for salt water, which does not affect it at all. Give it two or three coats of the varnish.—R. A. R. BENNETT.

[52078.]—**Granule Battery.**—You can use the carbon as many times as you like: it only wants washing in warm water after being used.—WATT.

[52079.]—**Waterclosets.**—The rats may have assisted, but leaden soilpipes are most dangerous, as the gas usually corrodes them sooner or later, and then the foul air escapes into the house. Glazed earthenware pipes are infinitely the cleanest, best, and most durable, but require careful fixing. They are to be had at the Birmingham Sanitary Association, 47, Colmore-row, who also supply the hopper basin and trap, which is far superior to the disgusting trap lever basin usually used. If there is a garden near, and soil handy, nothing is cleaner, simpler, and healthier, than an earth closet. There is a capital little illustrated pamphlet on house drainage for 1s. or 1s. 6d.; but I have lost mine, so I cannot say where it is to be obtained. Every soilpipe should have a ventilating pipe, not under 4in. diameter, to convey all foul air to the top of the roof. If wanted, I can ascertain the address of the pamphlet, and send it.—STRETTON.

[52079.]—**Watercloset.**—The probable cost of glazed drainage pipes is very small. You might get them at 6d. apiece. They would last a very long time if protected from breakage. I am afraid, however, that with these materials and the labour of a good carpenter you would not be able to make a good job of the repairs. The holes in the lead pipe may have resulted from either of the causes you mention, but perhaps the first is the more likely one, especially if the soil-pipe is not carried up beyond the upper closet, and if it does not terminate with an open end, so as to form a free communication with the outer air. Whatever the soil-pipe be made of this is necessary, and it should be carried up of the full size all the way and terminate above the roof, the closet outlet pipes forming so many junctions with the main vertical soil-pipe. You ask for a book. I do not know that you can do all you wish to do from book knowledge; but if you can—that is, if you dare, from the nature of the bad case you have stated—wait a few weeks, Messrs. Crosby Lockwood and Co. will have ready the second edition of a small book written by myself, which may afford you some information. Your best way, however, is to have the place thoroughly examined at once.—C. S.

[52080.]—**Water Main.**—I do not see that you need take out the pipe at all. You could easily have the new connecting pipe flange made to same radius as your 20in. pipe, and drill a hole to the required size. You will see that this is a much cheaper and readier way than what you proposed, and only one joint to make in 20in. main, instead of three, as you would have with a new pipe.—LABOR OMNIA VINCIT.

[52080.]—**Water Main**—No, do not "take sledge and break pipe." Remove "pipe" more gently by taking out the bolts of the nearest flange joint; remove the back-flap valve, if there is one, and draw back the socket of the pipe you want to remove; clear off the end of the next one, and replace it with a new pipe with proper outlet, which you will have ready to put in without delay. —C. S.

[52081.]—**Marks on Silver Plate, &c.**—"Real" silver is the term used to distinguish silver from nickel, Nevada, and other imitations of silver, while "fine," "sterling," and "standard" are used to denote silver of the Government coinage, or standard fineness. The mark of a "lion passant" is used by the Assay Office to certify that the article has been assayed and is up to the standard.—W. A. T. C. H.

[52083.]—**Punching Machine.**—The pressure required for shearing or punching may be calculated by means of the following formula:—

$$P = fct;$$

t is the thickness of the plate; c the length of the cut; that is the breadth of the plate for shearing, or the circumference of the hole for punching; so that ct is the area of the shorn surface, and f the co-efficient of ultimate resistance to shearing; which may be estimated for steel at 30 tons per square inch. Therefore the pressure required to punch a 2in. hole 2in. deep is 377 tons.—LOANHEAD.

[52087.]—**Pressure on Crank-Pin.**—Usually, in beam engines, the weight of the transmitting parts is balanced—that is, the weight of the connecting-rod, cold water pump, &c., equals the weight of piston, air-pump, &c., so that there is no weight either for or against the piston. In such a case, the strain or pressure on the crank-pin is equal to the areas of the pistons multiplied by the effective pressures upon them. Now, if we apply this to your case, we shall obtain the following results:—Area of low-pressure cylinder = 490·875 sq. in. × 62lb. = 30,434¼lb., and area of high-pressure cylinder = 268·8 sq. in. × 18lb. = 4838·4lb.; but half of this can only be taken as effective, it having only half the leverage of the other end. Hence, the total weight on the crank-pin is equal to 32853·45lb., or a little over 14½ tons. Of course, should there be any weight acting for or against the piston, such weight will want adding or subtracting to get the true weight on crank-pin.—ENGINEER, Dewsbury.

[52088.]—**Black Stain.**—I don't think you will be able to get a stain to stand hot or cold water. Have you tried Stephens's black stain coated over with varnish?—A. BEST.

[52089.]—**Frosted Tin Tubes.**—This is done by washing the tin tube first with alcohol, which removes any grease, &c., on it, and afterwards sponging it with a mixture of one part hydrochloric acid, one part nitric acid, and three parts of water. (See "Moire Metal," Vol. XXXVII., p. 320.)—R. A. R. BENNETT.

[52089.]—**Frosting Tin Tubes.**—Under the heading of "Moire Metal," this query was answered in No. 950, p. 320. I believe the best method is to heat the tin plate until rather too hot to hold; then dip in a mixture of hydrochloric acid, 1; nitric acid, 1; water, 4. Rinse, dry in hot sawdust (which must be from non-resinous wood), and lacquer—the plate being still hot enough, so as to do everything at one operation as it were. I think Mr. Wenham was the first to describe this process some years ago in these pages, under the head of crystallising tin plates.—NUN. DOR.

[52094.]—**Lost Watch Wheel.**—To "R. E. B." —I cannot give you any information about the acid. As regards the second query, you do not say if it be a pendulum or balance clock. Firstly, assuming it to be a pendulum, perhaps the m.s. is too strong, as when wound up to the top it may cause the pallets to "bottom"—i.e., cause so great an arc of vib. as to dip the pallets into the spaces of the escape wheel until they butt or jam, and then rebound, causing quicker vibs. until the force of m.s. is relaxed: then the pendulum will vibrate naturally, and of course go slower than before, and this is very likely to be the case with a deadbeat pair of pallets. You must carefully look to this. Again, if there be banking pins to the crutch, the latter may touch the former; if recoil pallets, the *time* of vibration of pendulum will be shorter with more power, and slower when the m.s. is weaker. Secondly, if a balance, it may vibrate too much, and strike the bankings, or the outer coil of the balance spring may touch the stud or curb-pins when clock is wound up, and not do so when having gone down four or five days; curb pins may be too far apart, balance spring touching them when m.s.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Practical Chemist" has replied to 51231; R. A. R. Bennett, 51421, 51613.

51434. Small Thresher, p. 566.
51439. Photography on Wood, 566.
51441. Arunto, 566.
51442. Restoring Leather, 566.
51449. Railways, 566.
51452. Gelatine Emulsion for Slow Plates, 566.
51453. Vines Shanking, 566.
51455. Coloured Films on Metals, 566.
51457. Portrait Frames, 566.
51460. Fret Cutting, 566.
51463. To Mr. Wetherfield, 566.
51465. Oil, 566.
51470. Notice to Quit, 566.
51471. Gunmetal Castings, 566.
51472. N.E. Locos., 566.
51473. Quinsey, 566.
54476. Masts of Racing Boats, 566.
51477. Decaying Feathers, 567.
51478. Legal, 567.
51485. Engine Query, 567.
51489. New Zealand, 567.
51490. Noise in Lavatory Waste, 567.

5 706. Model Boiler, p. 72.
51707. Texas, 72.
51711. Greenhouse—Valves in Hot Water Pipes, 72.
51712. Stone-setting, 72.
51726. Boiler for Small Boat or Canoe, 73.
51727. Alexandra Beehive, 73.
51742. Induction Coil, 73.
51758. Fyfe-Main Arc Lamp, 73.
51761. Magneto Machine, 73.
51763. Dividing Engine, 73.
51764. L. and N. W. Locos., 74.
51766. N.S.R. Locos., 74.
51773. Cutters, 74.
51789. Cleaning Sulphured Yarn, 74.
51790. Bias Measurement, 74.
51799. Single Acting Engine, 74.

QUERIES.

[52118.]—**Tarring Posts.**—Is the application of gas tar a preservative to a redwood paled fence in the open air? I have always thought it was; but the principal of a large country joinery firm, who does a good deal in gates and fencing amongst farmers, says it is best to leave the fence in its natural condition, as the fir will last longer untarred. Who is right?—M. C. H.

[52119.]—**Misshapen Chest.**—Would any of your medical correspondents inform me if anything could be done for my son (18, and striking to a smith) who, unlike anyone else that I know of, has a sharp boney ridge in the centre of his chest, and says his head often aches in connection with this unnatural formation of his chest? Any information that would relieve him would greatly oblige.—T. T.

[52120.]—**Engine Query.**—Will the condensing power of the engine be reduced by cutting off the exhaust at an earlier part of the stroke?—C. Guillaume.

[52121.]—**Scribing Block.**—I shall be obliged if some of the readers will give me sketch and dimensions of a scribing block such as they use in most engineers' shops?—A. G. Bilcliffe.

[52122.]—**Phosphor Bronze.**—What is the best method of reducing an inch bar of cast phosphor bronze to No. 6 wire?—A.

[52123.]—**Oxide of Copper Battery.**—Would any of the readers, who have made and used this battery, give me information how to make it?—also their experience with its use, and if it can be applied to the working of electric bells with success? Is the "Sutton" storage cell any good to an amateur for working a motor and an incandescent light? Ivanhoe.

[52124.]—**Precipitation of Copper.**—Mr. Allen states in "ours" of last week, that by using zinc, a purer precipitate of copper is obtained than by using iron as a precipitant. In the practical assay of copper by the cyanide of potassium process, Steinbeck's, described in Mitchell's "Practical Assaying," last edition, I find it almost impossible to extract the salts of zinc previous to titration, and consequently, for years past have used iron. Will Mr. Allen or any of ours kindly tell me how to purify the copper in an easy and rapid manner when thrown down by zinc, or to prevent it from being contaminated by the latter? Mine Agent.

[52125.]—**Harmonium.** Would any of the readers of the "E. M." please state what should be the size of the apertures in the valve-board for a 2½ set harmonium, and the best way of fixing the valves?—also, whether it would be practicable to include an octave coupler on the instrument, and if so, give particulars for constructing the same?—Phono.

[52126.]—**Microscopical.**—Putting aside the question of cost, what is the best form of camera lucida to (1) work with the microscope vertical?—and (2) work with eyepieces of different power? Does Grunow's fulfil those conditions?—W. Lamont.

[52127.]—**Platinum Crucibles.**—Will any of our chemical readers kindly say what substances may not be fused in platinum crucibles? Has sulphur any detrimental effect, upon the metal platinum when heated to great heat, such as over the Herapath blowpipe?—Platinum.

[52128.]—**M.S. and L. Engines.**—Can any correspondent give the dimensions of the new M.S. and L. single engines running between Grantham and Manchester?—Lincoln.

[52129.]—**Polishing Tiles.**—Can any reader kindly inform me if it is possible to give a permanent polish to common red and black kitchen tiles? They are very dull, and in consequence show every spot of dirt, which requires a great deal of scrubbing to remove, whereas the polished ones are very easily kept clean.—H[illegible].

[52130.]—**Water Rate.**—The Water Company have sent to me a "revised rate" claiming four shillings per annum more than hitherto. In answer to inquiry, they have an anticipatory printed reply, quoting thereon Act 15 and 16 Vic. cap. 156, and they now make a charge of 4s. for the water closet, independently of five per cent. upon the full rental. My question is this:—Inasmuch as the w.c. forms *per se* a part of the house on which a percentage is already charged, does the law protect them in thus surcharging their customers? Will Mr. Wetherfield or other legal friend of "ours" kindly advise?—Markwell.

[52131.]—**Boiler Query.**—I have been making a model boiler. The plate is 1-16in. thick; all rivets ½in. apart; height of boiler 15in. by 6in.; firebox 5in. deep; inside casing, copper, 1-16in. thick. What pressure should it stand? It is a model beam engine I want it to work. Size of cylinder 1½in. bore, 3in. stroke, and condenser. What power should it have, and is one pound pressure of steam equal to an ordinary pound weight? If not, what is the difference?—Blacksmith.

[52132.]—**An Excellent Yeast.**—Although "E. R. D." has followed the directions as given by "Barley Bread," in reference to the above, from some cause the result hitherto has not been sufficiently satisfactory. Its colour and general appearance is certainly that of excellent yeast, but, so far as my experience has gone, it does not possess the requisite strength. It answers very well mixed with an equal quantity of other yeast, but useless by itself. As I am very anxious in the matter, any further information respecting it from "B. B." will oblige.—E. R. D.

[52133.]—**Sulphur in Coal Shaft.**—I am working in a shaft in which there is a large amount of sulphur which nearly blinds all the men and myself. I am obliged to lose two or three days frequently and be closed in a dark room. Symptoms are like sand in your eyes, smarting pain, and excessive moisture. What can I do to prevent or alleviate the symptoms?—Colonial Collier.

[52134.]—**Cabinet-Making.**—To "J. P."—As one who is much interested in the articles on cabinet making, I beg to ask "J. P." if he will kindly include in his pages the way to make a mahogany wardrobe of 4ft. or 4ft. 6in. in width? Nothing of the sort has yet been given in the "E. M.," and doubtless many would be glad to receive help and instructions in this besides—G. W. J.

[52135.]—**Mechanical Race Course.**—I shall be extremely obliged if any correspondent will inform me how the interior mechanism of this interesting toy is arranged? The mechanical race course I allude to is at the Royal Aquarium, Westminster.—A Seven Years' Subscriber.

[52136.]—**Galvanising Wrought Iron.**—In galvanising wrought iron are there any points to be borne in mind so as to reduce the injury to the iron as much as ever possible? In galvanising small forgings, some people dip the article into water immediately it comes out of the bath. Has this any effect on the iron?—T. B.

[52137.]—**Electro - Magnet.**—A 4in. signal bell whose magnet core was 2in. long by ⅜in. dia., wound with 7 layers of No. 28 wire, has been replaced by a 6in. bell, whose magnet core is 3in. long by ⅜in. dia., the bobbins 2¼in. dia., wire No. 20, 15 layers on each limb: weight of wire about 2½lb. A battery of 6 large size Leclanchés worked the 4in. bell powerfully, but the 6in. instead of being as expected (very much louder), can only be heard the same distance off. Was it a mistake to have wound with wire so stout as No. 20? Should a better result be expected by connecting the bobbins so that current divides and traverses each simultaneously? Would a Fuller's battery be more suitable for the magnet wound with No. 20 wire, or would two bobbins wound with about seven layers of No. 28 be more likely to get the full power out of the core with the existing battery of Leclanchés? It should be added that the six cells have, as an experiment, been coupled up for quantity; but with no better result. The line wire is only about 100 yards of No. 20, earth return. The advice of a practical reader would be much appreciated.—James Edwards.

[52138.]—**Copying Negatives for Lantern Slides.**—Can any kind reader give me full and explicit instructions for making good lantern transparencies from ordinary quarter dry-plate negatives?—Dozey G.

[52139.]—**Bearings.**—I have an upright shaft 6in. diam. with two bevel wheels and plummer block on top. The brasses in plummer block have worn about ⅛in. oval where the two brasses join, and it throws shaft out of plumb. I have turned brasses round about so as to put the shaft plumb, but the bearing is still larger than the shaft, and the shaft trembles. What can I do to make the bearing smaller? I cannot let the brasses together as they are worn the wrong way. There is no provision made to let plummer block cover together. Perhaps some of our readers have had bearings of the same, who will let us know what they did to them. I have been told that metal can be run into bearing. Hope some one will let us know how to use that metal and oblige.—C.

[52140.]—**Spinning-Mule Ropes Wearing.**—Will any reader kindly say what is put on to mule rim ropes, that drive the tin rollers, in the shape of grease (?), &c., to keep them from wearing away? Perhaps "J. P., of Burnley," having been 15 years in the spinning-room, will kindly say?—G. Hartley.

[52141.]—**L. & S.W. Engines.**—Could "C. R. M., of New Zealand," or any one else, give an account of Beattie's firebox, boiler, and feed-water heating apparatus at one time on this line? Also, were they adopted by any other co.? What sort of engines were those of Mr. Gooch, loco. supt. 1841—50?—W. B. P.

[52142.—**Resistance Coils.**—I am at present making a resistance box to contain 15 coils from ·1 ohm up to 5,000 ohms resistance The coils are to increase by the numbers 1, 2, 3 and 4. The box is 6 by 6 by 3½in. inside. Please let me know the thickness of G.S. wire for each coil? Wire wanted as thick as possible.—Volt.

[52143.]—**Chemical.**—I have been working out Thorpe's "Chemical Problems," but have been stopped by No. 43, and should be obliged by information as to the way to work it. Question 43: Determine the amount of aqueous vapour in a sample of air which yielded the following numbers on analysis Bunsen, :—

Air saturated with moisture.

Observation at lower level of mercury...	565·9
" " upper " in eudiometer	317·3
Volume corresponding to division 317·3 =	292·7
Correction for the meniscus....................	·4
Temperature of the air	20·2° C.
Height of the barometer	0·7469m.

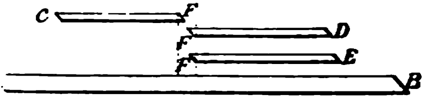
The same volume of air dried by calcium chloride.

Observation at lower level of mercury...	565·9
" " upper " in eudiometer	310·7
Volume corresponding to 310·7 =	286·0
Correction for the meniscus	·4
Temperature of the air	20·2° C.
Height of the barometer	0·7474m.

Also question 31. At what point are the numbers on the scales of Fahrenheit and Celsius identical?—Castor.

[52144.]—**Gun Query.**—For the last eight years I have shot with a gun made specially for me, and although it has not more than ordinary recoil, about four years ago I was punished with it, and this season at first day's shooting was quite crippled. I find that unconsciously I get the gunstock upon the muscle of the arm below the shoulder, where I am bruised at each shot fired. Have tried lengthening and padding stock and coat, and lessening charge—considerably deteriorating my shooting thereby. My gun would be none the worse if stock were shortened; but I am afraid that reducing the weight would increase recoil, besides destroying the balance of gun. Can any one tell me with certainty the effect of shortening stock, as it possibly might enable me to shoot more from the shoulder? Gun is 12 G.C.F., weight 7lb. 1oz., usual charge 3drm. powder, 1oz. shot.—H.

[52145.]—**Springs.**—Perhaps one of your readers will kindly give me some advice in the selection of a spring? The sketch will enable the matter to be better understood. A and B represent two pieces of wood about an inch wide and an inch apart; C, D and E are three brass blades lying between A and B. I want to find the most compact and suitable springs to fix in positions F, to turn the blades, when not held back, from right to left (thus describing a semicircle), as C is supposed to have done in the sketch. They need not be very powerful ones.—Inexperienced.



[52146.]—**Telegraph Wires.**—I have some buildings, and also a plot of land that may or may not be built upon in twelve years' time, which are networked over with telegraph wires. I shall be glad to learn if a twelve years' user of these wires, without acknowledgement or a special agreement, will give the Post Office authorities the right to keep the wires in position, notwithstanding that the altitude of the wires is so low as to prevent me from erecting high buildings on the plot, or elevating existing ones. This is a very important question, affecting, as it does, property all over the United Kingdom.—Blackburn.

[52147.]—**Chilled Roll Turning.**—What travel should a gauge have to secure a good tight fit?—A. R. Wilkinson.

[52148.]—**Testing Lightning Conductors.**—What is the practical method of testing a lightning conductor for good earth? If I connect one pole of a battery through a galvanometer to the lightning conductor, and the other pole temporarily to earth, with no gas or water pipes available so as to be sure that this second (temporary) earth is a good one, supposing I get a weak deflection or none at at all, how am I to be sure that the fault does not lie in the temporary earth connection, and not in the permanent earth of the lightning conductor? Or is there some other better mode of testing?—H. E. H.

[52149.]—**Cotton Spinning.**—Can any reader inform me of what steel cotton spindles are made? Would it be suitable for making cutting chisels or drills?—J. C.

[52150.]—**Poor Law.**—To Mr. Wetherfield or "Lex."—A man leaves his wife; she goes to the union; the guardians take proceedings against him; the magistrate makes an order for him to pay so much per week; he pays it for some time, then stops payment. Can the magistrate enforce his order without the wife again applying to the union, and is she bound to make a statutory declaration or affidavit that she is destitute?—P. M.

[52151.]—**Ammonia and Alcohol as Sources of Motive Power.**—I have latterly been experimenting with various gases, such as ammonia, alcohol, &c., with the view of ascertaining if they can be used as a means of producing motive power in engines, and I supposed I had attained satisfactory proof that these, and similar gases, might be used as a vehicle of heat in lieu of steam. On looking over the records of the patent office, I find, however, that several scores of patents have, at various times, been taken out for modes of using these and other gases and vapours as motive agents, and several of these patents give descriptions of engines which, apparently, would fulfil all the conditions required. Nevertheless, no engine working by the expansion of these chemical gases is at present in use, as far as I am acquainted with. It might be of general interest to your readers, as well as to myself, if you, Sir, or any of your correspondents would kindly inform me, through your columns, why engines working by such gases have hitherto all proved failures? Theoretically, there ought to be a great saving of fuel, as these substances have a very low boiling point, and at temperatures much below 212° give a pressure of double or treble that of steam at 212°. I am inclined to suspect that the reason of the failures has hitherto been on account of the difficulty of confining the gaseous fumes within the present form of steam-engine and packings now used. Any information you can give will oblige.—EXPERIMENTER.

[52152.]—**Frush Dynamo Machine.**—Will "Light" accept my best thanks? In the winding of my machine at first, I think I wound it similar to his suggestion, connecting the inner end of one coil to opposite coil's commencing end, the wires running diagonally across ring, with very poor success. The description given in *Engineering* is this: Wind all coils in one direction, and connect all inner ends together, and carry outer ones to commutator. This I've done without meeting with any better results. The arms or boss which carry ring are not insulated from each other. Is this necessary? If so, the fault is here. The arms are in one piece, and driven tight into ring. Will "Light" kindly assist me in this?—WILLIAMS.

[52153.]—**Lens.**—Will Mr. Lancaster kindly help me with the following? I intend grinding a compound condensing lens, 8in. diameter, for photographic enlargements. The front combination I purpose using with the condenser, is a good half-plate portrait lens of 8in. focus. I shall be glad to know what are the best curves to grind each lens, and what glass to use? Will ordinary plate-glass answer for this purpose?—JAVAN.

[52154.]—**The Ross Battery.**—This battery for the electric light is mentioned by Lord Bury in the July number of *Nineteenth Century*. The inventor is Mr. O. C. Ross, C.E. Can any obliging reader tell me how it is made? A still more convenient battery is mentioned in the *Times* of Oct. 27th, as being employed on the Great Northern Railway in lighting Swan's incandescence lamps. It is said to be charged with a chemical which absorbs the hydrogen that is given off.—DYNAMO.

[52155.]—**Bicarbonate of Soda.**—Will some reader kindly give the details of the process for manufacturing bicarbonate of soda from soda crystals by means of carbonic acid?—A. D. C.

[52156.]—**Photographic.**—Lately I have had a great difficulty in taking my negatives clean, for when the plates have been developed and fixed, I find there is something forms upon the film like scum, which, when dry, appears to be like chalk. I find I can remove it by gently rubbing with a piece of wool; but the film being tender, it gets scratched, which causes further trouble. My bath appears to be quite bright and clear. My developer is always new; I use Mawson's collodion. Could any of ours tell me the cause and how I can correct it? And could you also inform me if cyanide should be thrown away as useless if it turns the colour of sherry: I find it does do so, when the redeveloper turns dark upon the plates? A developer giving great density, such as would be suitable for taking advertising bills, copying testimonials, &c., will oblige.—G. D. A.

[52157.]—**Legal.**—To MR. F. WETHERFIELD.—A daughter possesses property from her deceased parents; she dies unmarried; her brothers and sisters are also deceased. The next of kin is advertised for to her mother, in consequence of the father being illegitimate. Which is entitled to the property, the grandson of her mother's sister by first marriage, or son of her mother's sister by second marriage?—and are the sisters of the son entitled to a share, or the son to all, if any? Parents of son and grandson deceased.—W. S.

[52158.]—**Slide Rest.**—The bottom slide of my rest has a defect which I cannot understand. In surfacing with a fine point tool, at regular intervals, it seems to spring from the work and not to cut so deep, giving a corrugated appearance, and this is the case in working outwards from the centre, more than in working inwards to the centre. The screw thread is 10 to the inch, and the corrugated appearance is about the same distance apart; yet the slide appears to fit well and tight, and there is very little backlash. Can any of the readers of the "E. M." say what is the cause, and suggest a remedy? It is not enough to signify in ordinary turning, but in facing up work for ornamental turning ivory it is a great nuisance.—G. H. R.

[52159.]—**Speed of Dash Wheel.**—Will any of "ours" direct me how I am to proceed in the following matter? I am erecting a cylinder 6ft. diameter by 3ft. wide, divided into four compartments like a dash-wheel, and made of wood. I want the material that I am going to work to be knocked about from one side to the other, and I want the machine to revolve at a good speed, but not at that rapid rate that the centrifugal force will cause the material to circulate round with the periphery of the wheel. Neither do I want a speed that the material will only slip round and not be thrown—which is of the utmost importance that it should be. What size tooth wheel shall I want on the cylinder?—size of tooth-wheel and rigger in connection with same?—also size of rigger from main shaft, to produce the effect I desire?—or shall I want any tooth-wheels at all, but simply riggers?—if so, what size? Understand the material I shall work is heavy. My engine is a 3 h.p. vertical worked at 30lb.—POOR MAN.

[52160.]—**Battery.**—I have made some electric clocks which answer well while the battery lasts; the one now in use lasts about five or six weeks; by that time the zinc plates are eaten away—some of them completely through. The battery is, I believe, known as the Walker battery, and consists of a carbon and zinc plate in sulphuric acid and water. Is there any battery that will last longer than this one? The circuit is closed for a half-second twice a minute, and the current needed to drive the clocks is about equal to that given by ten No. 2 Leclanche cells.—SALOPIAN.

[52161.]—**Spectacles.**—In using spectacles to correct the defect of short sight I find that many make the type appear much smaller than it really is. Will Mr. Lancaster, or some other optician, kindly say if this should be thus? I also find that after using the specs. for a time, on removing them vision is for a moment or two misty. What No. spectacles should be used by one who cannot see to read this query clearly at a greater distance than 6in., the object being a pair of specs. that will enable him to read it, or music, at a distance of 2ft.?—S. R.

[52162.]—**Legal.**—A grocer licensed to sell spirits, &c., supplies the wife of a customer with some (say) brandy, and at her request he puts it down in the bill as "sugar" supplied. The husband, after paying for it, discovers the real state of affairs. Has he any legal power to prosecute the grocer, and if so, under what category would such a case come—as "fraud," "obtaining money under false pretences," or what?—AN ANXIOUS ONE.

[52163.]—**Pile Work.**—Could any one kindly inform me what is the best way to make looped or terry work without using wires?—WEAVER.

[52164.]—**Leather versus American Cloth.**—I have seen it stated that "the American cloth used for covering perambulator hoods is dangerous to health, owing to a poisonous lead compound used in its manufacture." Is this correct? For this reason, and on account of the cracking, I wish to re-cover mine with real leather. Will some practical subscriber of ours please give me a few hints, and the name of the correct leather to use?—F. W. P.

[52165.]—**Slide-Rule Formulæ.**—I should be glad if someone will point out the broad principles on which these are constructed. I can make my own formulæ in cases which can be solved by simple proportion; but I do not yet grasp the mode of tackling formulæ involving quantities which vary as the square or square root of other numbers. For instance, what would be the steps leading to the following setting of the rule?—

A. 183
B. Ft. per min. of piston
C. Cub. ft. per minute
D. Dia. of pump in inches

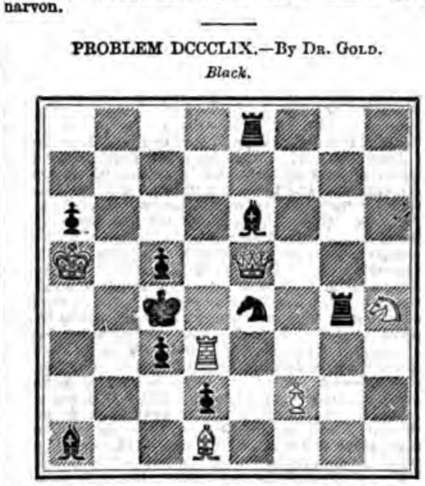
This setting gives the diameter of a pump direct, and I should like to know the principle on which such settings are determined.—GLATTON.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLIX.—By DR. GOLD.

Black.



White. [6+10

White to play and mate in three moves.

IN the last number the name of the second prize-winner should have been G. J. Slater, that of the third D. Mackay. C. Planck is fourth in order.

SOLUTION TO 857.

White.	*Black.*
1. Kt to Q B 7	1. Anything
2. Q, R, Kt or B mates or Kt discs. mate	

(Eight variations.)

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 856 by F. T. Bidlake, Dicky Sam, Rev. W. Anderson; to 855 by W. Anderson; to 857 by R. A. Bennett, S. Seymour Follwell, F. V. P., Dicky Sam, F. T. Bidlake, C. Planck (its main points are the near ties by 1. B-Q R 3 and B-Q 6, and the neat idea embodied in the play of Black's Queen's Pawn. There is a bad dual if 1. $\frac{\quad}{\text{B-B 5}}$ and minor duals to two moves with Q; still, I consider it an extremely fine problem).

J. JOWETT.—We will find you an opponent as soon as possible.

A. SEWELL.—We should advise you to get Gossip's "Analysis of the Openings" and study them carefully. Also a good collection of games, such as "Chess Masterpieces" or Staunton's "Chess Praxis." We are not sure of the prices. Join some club and play frequently with better players than yourself, accepting odds.

C. E. B.—Your four-mover can be done thus 1. $\frac{\text{Kt-K4 (ch)}}{\text{K-B4(best)}}$ 2. $\frac{\text{P-Kt 4 (ch)}}{\text{K-B 5}}$ 3. R-B 5 (ch) and 4. R mates.

WE have received Mr. J. P. Taylor's report of the two-move tourney. He found it exceedingly difficult to settle the order of the first four problems; but the following is the result:—

Motto.	No. of Problem.	Marks.	Author.
1. Chacun à son Gout	849	30	D. Mackay.
2. R. I. P.	838	29	F. O'N. Hopkins.
3. Timeo Danaos	853	28	A. E. Studd.
4. What's in a Name?	846	27	C. Planck.

Mr. Mackay therefore wins the first prize, a copy of "English Chess Problems," and Mr. Hopkins the second, which should be "Chess Chips"; but as the work is out of print, one of equivalent value must be substituted.

THIS Tourney has also been a great success as regards the *quality* of the problems entered: we only wish the number had been greater.

NEXT week we shall publish the result of the Solution Tourney.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 894, 897.
Bookbinding: Nos. 613, 627, 770.
Cements: Nos. 377, 729.
Coils, induction: Nos. 620, 640, 779, 797, 832, 885
Coils, medical: Nos. 844, 898.
Copying processes: Nos. 750, 753, 761, 762.
Electric bells: Nos. 545, 558, 797.
Electric machines: Nos. 368, 380, 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Electro-plating: No. 833.
Lacquers: Nos. 429, 475, 622, 866.
Magneto-electric machine: Nos. 376, 589, 783, 826.
Nickel-plating: No. 808, 811.
Silver-plating: Nos. 830, 868, 869, 870, 871, 874.
Telephones: Nos. 692, 695, 747, 781, 809, 825, 846, 853, 865, 894.
Varnishes: 321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 31, **and unacknowledged elsewhere:—**

W. H. HARLING.—W. Lachlan.—Mawson and Swan.—J. B. Bowman.—J. W. and W. Grimshaw.—Experimenter.—Good Time.—A Fellow of the Royal Astronomical Society.—A. W. Nicholls.—S. E. Kelf.—J. Nicholls.—C. R. T.—J. R.—Clock Star.—J. R. Pridham.—A. S. L.—One who is Perplexed.—A. Laundry.—A. Best.—W. R. H.

A. S. (There is no known method of doing what you require. That is the reason the carbon paper is used.)—H. NETTLETON. (See several recipes in back volumes. Slightly damp the spots and expose to sulphur fumes; or try solution of chloride of lime, carefully washing off afterwards. It is not easy work, for something depends on the nature of the spots, and very much on the experience of the operator.)—JACK, THE POOR BOY. (The only way is to make a flue somehow or the other, for even the oil-stove will necessitate ventilation. Perhaps a fire could be lighted outside, and be made to warm the office by heating the air supply, or by radiating heat from a metal screen let into the wall. It depends entirely on the construction of the office.)—INQUIRER. (You want a medical coil, we suppose. See the index of the last volume.)—FLEUR DE LIS. (Read up the subject in back volumes, or the present series on "How to Make a Dynamo.")—CHOIR MASTER. (It is made of glycerine 4, glue 1, and sufficient whiting to colour, known by several names. See list of Back Numbers above, inserted in this column first number in each month.)—AMATEUR SMITH. (The degrees of temperature of steel at various colours have been frequently given; but if you will read an article on p. 561, No. 842, it may give you the information you require. The other temperatures are estimated only. 2. Your rule is quite correct for any degrees above freezing point. We do not understand how you could find it incorrect, for each degree C. is equal to 1·8 degree Fahr. Your thermometers must be deranged. 3. Use a crucible; but the best way is to make a solution of the borax, and crystallise it out at a temperature between 60° and 80°. The octahedral crystals are better than the crude borax for all purposes of soldering. Some smiths boil 16 parts of borax with one of sal-ammoniac for an hour, and when cold grind into powder. That is said to be excellent for welding cast steel.)—Etna. (See previous answer, and several replies in back volumes. There are many tables of the kind; but as to the weight that has generally to be worked out for every beam, &c.: something, too, depends on the quality of the iron. Molesworth's Pocketbook would be useful to you.)—Mechanic. (See Dr. Edmunds's paper on Acne, p. 543, No. 881.)—Sanitary. (It is used as the basis of a disinfectant, but it is doubtful whether it has much power. It is solid at ordinary temperatures, but vapourised, and mixed with air, forms an explosive atmosphere. It is slightly soluble in boiling water, and is not poisonous.)—Bunsen, Edinburgh. (How can we suggest without seeing it? Try the effect of the luminous flame by stopping the air supply through the pipes.)—American Organ. (Must run a rod across to take hold of all the mutes by levers; but no one could give explicit directions without examining the instrument.)—Young Glasgow. (Alum water would be the answer; but you had better ascertain the cause before applying any remedy—that is, obtain the advice of a medical man.)—Melbourne. (We know of nothing better than starch paste.)—N. M. D. (Certainly; portable steam cranes, for instance.)—J. B., Stainbro'. (Indiarubber solution we suppose you mean. That will adhere firmly to fresh-cut or clean surfaces of leather. 2. Soak in water and hammer while still wet.)—G. Smith. (Try French polishing. See pp. 175, 227, Vol. XXXII. You will find that in all probability the organ was purposely polished what you call "badly.")—R. G. (The method of putting invisible patches on boots with a solution of guttapercha in bisulphide of carbon was described on p. 560, No. 960. Indiarubber solution will do as well—perhaps better.)—Phythis. (There is no difficulty in getting needle manganese from any respectable dealer in chemicals or electrical sundries. See advertisements. 2. We scarcely understand, because if you have been a reader since 1876, you must have seen the very illustrations to which we should refer you. Try, however, pp. 38, 65, 90, last volume, and say what it is you wish to know, if not there.)—Plato. (There is nothing the matter with it, except that it is not a first-class watch. You should keep it as much as possible in one position. If you wish to know the cause, see the indices of recent volumes.)—R. J. P., Port Said. (We know of nothing better. Heat in an iron ladle and stir quickly with an iron rod. If it is inclined to be sticky add a little rosin. 2. It can only be liquefied by great pressure and low temperature. 3. If you mean the common rosin or colophony, it is soluble in turpentine, ether, alcohol, the volatile oils, and the fixed oils when aided by heat.)—Enquirer. (Molesworth's Pocketbook and similar works give table of weights. We do not know of any special tables.)—J. P. (You can apply for the surplus paid. Your local surveyor of taxes or collector will put you in the way.)—Edwards. (Much too serious for amateur homœopathic treatment. The disease is probably of a scrofulous character.)—W. H. Clarke. (We have no volumes on sale earlier than Vol. XXIV.; but you would probably get them by advertising in the "Sale" column for them, though we expect you would have to pay more than the published price, as they are scarce. The *British and Foreign Mechanic* was published separately till we incorporated it. It only published forty-three numbers separately.)—Fiddler. (Very glad to hear from you again; but sorry we are unable to insert a tenth of the letters that reach us on "Thought Reading," "Matter and Life," &c. The fact is, we have had almost enough of the subject, and are, besides, terribly pressed for space just now.)—Tradesman. (The city authorities can demolish your premises; but will, of course, compensate you. If you are dissatisfied with the amount they offer, and think you have a good case, you had better instruct your solicitor to sue them for the amount you claim, and let a court of law decide the matter. If the amount offered is anything near the honest value of your premises, take it and avoid litigation.)—Beehive. (Yes; publication would make the use of the additional substance public property.)—Alfred Slater. (Summon him before the magistrate, who will order him to abate the nuisance.)—Enquirer. (Mechanics, geometry, arithmetic (the higher branches), and some knowledge of the physical sciences, chemistry, &c. 2. See any list of books, such as that issued by Mr. Calvert, Great Jackson-street, Manchester. 3. There is no examination. 4. Seven is the usual term. Wages vary with the circumstances—particularly whether a premium is paid or not.)—Old Subscriber. (You are hard to please. If you want the substances named at all, you require only a few grains.)—Amateur Electrical Engineer. (We can only refer you to the indices, where you will find references to a number of transmitters.)—Apprentice Draughtsman. (The blue process was described so recently as p. 325, No. 950; also p. 64, No. 914.)—J. H. (You must first make the pattern, then the mould in proper sand, all of which details have been explained recently. For so small a quantity, one of Fletcher's furnaces would be best. See p. 394, Vol. XXXVII.)—J. (What do you want to do with it? See p. 455, last volume.)—J. W. B. (We gave a brief note on p. 36, and know no more than we found in the *Times*. We do not think it at all probable that the "inventor" will submit his motor to the criticism of experts. The account given in the *Times* is simply absurd.)—Warragul. (See p. 316, No. 924, and the indices. We cannot help you in the matter of "moon-dials.")—A. S. (You will find recipes for non-conducting compositions in many of the back numbers. It would be useless to quote, because you might not find the substances where you are going. Soda ash, or caustic soda, is useful for boilers, but much depends on the nature of the water.)—La Bouchere. (All your queries have been answered many times. For the mirrors, spread mercury on tinfoil, laid on a flat surface. Push the cleaned glass on to it in such a manner that it skims the mercury, and then weight down. The object is to bring a perfectly clean surface of mercury into contact with the equally clean surface of the glass. 2. For silvering, see p. 544, Vol. XXXV. The silvering paste you apparently mean is made of chloride of silver 3½oz., cream of tartar 7oz., common salt 10½oz. Reduce to a paste, and rub on the cleaned articles with a cork. 3. For regilding picture frames, see p. 258, No. 870.)—J. S. B. (If you cannot use one of Fletcher's gas burners, the water can be kept hot a very long time by inclosing the can in an airtight vessel, thickly lined with felt or other nonconductor. See indices.)—C. T. Ball. (If it lasted five or six hours you ought to be well satisfied. None of the bichromate cells are capable of running for a month (!) at full power—nor any other. Read up the subject in back volumes.)—H. E. H. (It is a defect inherent in the instrument, the exact cause of which is not known. It has very little to do with the matter to which you refer, because that is common to any one note, whilst in the telephone a number of notes, so to speak, crowd on one another. Read up the question in back volumes.)—Rosicrucian. (We do not understand what it is you wish to study. The spectroscope is explained in many textbooks, and there is a great deal about it in back volumes. Mr. Browning publishes a little book which may be useful to you.)—Pumper. (Your queries are much too vague or too wide. We cannot afford space to illustrate the details of a waterworks. You will find much information in "Waterworks for Cities and Towns," published by Lockwood and Co., Stationers' Hall-court, E.C.)—J. E. A. (So far as is possible your questions have been frequently answered recently. Lamps are now made of different power from one candle up to forty and more. The battery power required would depend on the lamps. Look up your indices.)—W. Ainsworth. (The preliminary rules refer to others, which can be had from the office. You had better wait until the new rules are published in their entirety.)—Bromide. (Perhaps it is given in the part "to be continued.")—A. G. D. (They are first carefully coated with isinglass size, and when that is thoroughly dry with best paper varnish. See that every part is covered with the size.)—Carrossier. (It was "chilled," that is the cause. Try what you can do with a light rubber moistened with spirits, or with a mixture of spirits and turpentine. 2. A series of articles on the subject of cart and wheel making was concluded in Vol. XXXVI.)—The Only Jones. (A variety of telephones have been described in back volumes; but to use one for business purposes would no doubt be infringing the patent. How would you obtain permission to erect the wire? 2. Gower-Bell transmitter, Bell receiver, and a switch board devised by some of the officials. They are all so sensitive that we doubt whether anyone has compared them. 3. Remove with putty-powder or rouge, and rub the wax on when the pipe is warm.)—Chelmsford. (You should have referred to number of reply, or at least to page. If it is the fault of the paper, surely that ends it. The second question is answered in effect in many back volumes, and in any handbook of the art. We should need to enlarge the paper to insert replies such as that solicited.)—P. J. D. (We do not remember the figures, but there are more acres in Yorkshire than letters in the Bible.)—Steam Ship. (At any mercantile marine office, or from the Registrar-General of Seamen, Adelaide-place, London-bridge.)—Broin. (Cover it with Leroy's composition. 2. Doubtful if any varnish will last long.)—A New Start in Photography. (Must be some fault in the burnisher, or in your method of handling it. 2. Due to over exposure and too much pyro.)—A Punt Maker. (Will not the sketch on p. 560, last volume, help you?)—T. R. S. (How can any one tell you how to introduce a brake that does not exist! If you wait until January next you will be able to obtain provisional protection for a sovereign, and then you can explain your ideas and show a model to any of the railway managers; but they have so many designs of the kind submitted to them that you will do well not to be disappointed if they decline to take up your invention.)—Inventor. (The question is not sufficiently definite. Under the new Act, notice will be given to both applicants where a second invention is entered before a patent has been granted to the first. If a patent is granted to the second, it will be as valid as any patent—that is, it will be void if when tested in the courts a prior patent covers it. 2. The sale of the article made under the first invention will not affect the patent.)—T. F. (We forget the exact sizes; but you can ascertain by writing to the office.)—W. E. Callaway. (One was illustrated on p. 112, so recently as Oct. 5.)—H. D. (Many metals when remelted lose their properties to a certain extent. Copper is not an exception.)—Tremolo. (See p. 330, Vol. XXI., and answer to "One in a Fix" on p. 139. It cannot be easily added unless there is a board between bellows board and reeds.)—Onward. (The manganese is mixed with carbon. See the indices under "Manganese" and "Leclanché.")—Electrician. (Nothing.)—Ignoramus, An Old Subscriber. (We answered you in this column on p. 162. Mixtures of coal gas and air, or of hydrogen and oxygen, will do. Other mixtures will also explode. It seems strange that the lecturer did not mention what he used.)—Anxious. (If you have subscribed to this journal for "some 20 years," you appear to forget that there is such a column as this, and when you write a second time add to our work by using another signature. Your question was answered on p. 139, to the signature "H." See pp. 527, 552, Vol. XXIX.; but take medical advice in time. See Dr. Edmunds' reply on p. 310, Vol. XXXV.)—Plum Rule. (We know of no rule except rule of thumb, which varies in different shops. Surely you can see some at the tool shops, and make yours to somewhere about the same dimensions.)—Intending Emigrant. (We cannot advise emigrants, especially when they have "no trade." For your ailment Australia would be a good climate, so would any of the countries having a dry and clear atmosphere. See p. 171, Vol. XXXIII., and the indices for remedies.)—Thos. Nicholls. (Read up the articles on the subject in recent volumes, and those now in course of publication.)—M. C. H. (Merely indicate the number of leaves in a sheet; the dimensions depend on whether foolscap, demy, crown, &c., sized paper is used, and even then only approximate measurements can be given.)—J. J. Clipsham. (You must burnish them if you want higher polish. See p. 169, Vol. XXXV.)—Learner. (Get Mr. Calvert's catalogue from Great Jackson-street, Manchester. The paper named is published in New York; can be had here only by subscribing for it.)—P. H. R. (Is not your query answered on p. 113?)—Chesterfield. (What with the ink you use and your handwriting your letter is nearly illegible. As far as we can see, the marriage was legal. If you have not the means to spare, keep out of Chancery and let the property go.)—J. E. H. (We have heard of similar cases before, but can hardly account with any certainty for them. Several hypotheses might be offered, but we have not the space to spare—nor, we regret, for the letter on "Life and Matter.")—Bertie. (Into a shop by all means.)—One of Ours. (We think the Statute of Limitations bars any claim by the executors.)—Silex. (The firm is a good one, and the contributor named is a member; but you cannot expect what you want for 6s. 6d.)—Caution. (He is, of course, not liable. If he had exposed the child in the carriage he would have been punishable, and justly: but do you really think fathers of families are to stay away from work when their children are down with scarlatina? With proper care the risk of infection is slight. Second query shall be inserted next week.)—Murano, Tasman. (In type.)

E. R. B.—J. N.—Thor.—A. R. S. M.—W. Turvey, and others have replied to queries already similarly or adequately answered.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 9, 1883.

THE DUKE OF ARGYLL ON GEOLOGY.

THE jubilee of the Edinburgh Geological Society was celebrated last week with a conversazione and an address by the Duke of Argyll, who took for his subject some of the more interesting problems which have been presented to us by our knowledge (such as it is) of the geological history of the globe. In his review of the salient features of modern geology, the Duke preferred to dwell on the immense extent of our ignorance compared with the little area over which our knowledge has been established, and he did not hesitate to point out that those very views which he regards as erroneous have been the means of immensely increasing our knowledge of facts. That is the great advantage of rival theories when supported by men capable of putting their own views forward in definite shape and based upon observed facts. In fifty years—since the establishment of the Edinburgh Society—we have made great advances in geological knowledge, and views then held with much show of reason have given place to others based upon a more intimate acquaintance with the strata and life-remains of the earth. The leading idea of the Huttonian hypothesis was the uniformity of geological causation — an hypothesis which led to the famous formula that in geology there is no trace of a beginning, no symptom of an end. It is not to be wondered at that such a doctrine was at once stamped as atheistic, a charge that was not withdrawn altogether even when it was explained that Hutton meant only exactly what his words said, and that for a beginning we must seek beyond the boundaries of geological phenomena as then known. The Duke of Argyll says that it was not possible to be really satisfied with the Huttonian hypothesis as a full and final account, for some other key to geological facts than mere mechanical repetition was needed, and that has been found within the last fifty years in the recognition that the rocky records contain indubitable evidence of a rising and expanding fauna. Following Hutton and Playfair, came Lyell, the great law-giver in the philosophy of geology, as the Duke calls him, although he immediately afterwards states that Murchison never did accept Lyell's doctrines as an adequate or consistent explanation of numberless facts respecting the succession and condition of the rocks. Murchison could not conceive of those facts being all accounted for on what he termed the "bit by bit" theory. The Duke, however, does full justice to the work of Lyell, and remembers the keenness and enthusiasm with which the great geologist often related to him some new discovery illustrating the vast antiquity of even the last and latest changes upon the surface of the earth; but he suspects that Lyell, like most of us at times, confounded two very different things—the continuity of causes and the uniformity of effects. In the first of those the Duke believes, but he cannot believe in the second, and it is because he accepts the former that he finds it impossible to believe in the latter. Everything that appears to us to be in stable equilibrium is being attacked by causes acting with infinite slowness; but a time must come, with more or less suddenness, as we call it, when, the equilibrium being overthrown, a "catastrophe" follows. These catastrophes have homely illustrations in every-day life, and the traveller not infrequently sees them on a larger but still small scale in volcanic eruptions, tidal waves, and disruptions of apparently permanent mountains of ice in the Polar regions. The energy which produces those effects is of secondary magnitude to that which has given a definite direction of dip and strike to whole masses of sedimentary deposits, which is far deeper seated and more powerful than that which has brought about the raising or destruction of a volcanic cone at some comparatively isolated part of the globe. The outburst of a volcano is only the sudden revelation of causes which have long been silent, but have never ceased to work, and it is reasonable, arguing from the known effects of volcanic eruptions, to believe that similarly sudden revelations of a more central force have produced the effects we witness on the crust of the earth. Such catastrophes as human beings have witnessed and recorded are measured by the scales of pigmies, and are really of but infinitesimal magnitude on the scale of Nature. The upheaval of such a mound as that of Mont Blanc, depicted on a circle 64ft. in diameter, looks almost infinitesimal; the greatest irregularity on the earth's surface, reckoning from the highest height to the deepest depth, is less than 60,000ft., and, stupendous as that may seem, it is really very small compared to the size of the earth. As regards any visible effect of subterranean forces upon the crust, there is no so-called catastrophe which is not well within the reach and compass of the forces to which it has been ascribed; and if we cannot interpret with any approach to agreement those changes which have taken place in, as it were, our own time, how shall we attempt to interpret those which occured in palæozoic and mesozoic ages? The doctrine of uniformity, as understood and applied in England, has, the Duke of Argyll believes, long exercised a most injurious effect on some of the more pressing of geological problems—those concerning the most recent events—such as, e.g., the coming on of the glacial age; the great submergence which accompanied it; the coming in of the great Pleistocene mammalia; their destruction, and the breaking up of old surfaces which accompanied that destruction; the distribution of gravels and muds; and so on—all questions concerning which various discordant theories are advanced, which the Duke thinks are directly due to the prejudices and prepossessions of the Uniformitarian Theory. He accepts as one of the most certain conclusions arrived at by geologists that there has been, very lately in the scale of geological time, a period when the climate in these latitudes was glacial: he lives amongst the facts which prove it, and he has no doubt that ice has worked on the Argyleshire hills in the two forms of glaciers and floating masses. It is also fairly certain that the ice worked at two levels, one about 30ft. above the present sea-level, the other at a level much higher up the flanks of the hills, and, as regards the lower ranges, at or above their summits. The conclusions which have been arrived at as to the higher level do not agree altogether with the Uniformitarian hypothesis, for the glacial sea, if it ever existed, has not left any evidence of a prolonged stay on the mountains of Argyleshire. There are no beds containing marine shells, the relics of animals which might have lived and died on the spot; and in the rare cases in which they are found at all they are generally broken, or are so grouped as to show that they were empty shells when drifted and imbedded where they rest. In view of those facts, the Duke of Argyll says that the submergence of the mountains under a glacial sea must have been essentially transitory in its character, whilst the extreme recency of both the submergence and the re-emergence, belonging as both do to the times of the existing fauna, compels the supposition of movements which have been relatively very rapid. That is one phase where, he thinks, the Uniformitarian shoe pinches; he finds another in the boulders, for, as he says, for one perched boulder in the Highlands which can be accounted for by the lateral moraines of a glacier there are hundreds of thousands which lie where no glacier can ever have placed them; further, he urges that there is no proof that an ice-cap ever existed, or that if it did it could have placed boulders where they are now seen. The glaciation of the mountains was, he thinks, accomplished by the infringement of floating sheets or masses upon particular portions only of the surface. Speaking of the Loess, the Duke does not pretend to solve all the difficulties; but he is sure that many would be removed if we did but face the conclusion that there was over a large area of the northern hemisphere a great depression and a great re-emergence of land towards the close of the glacial epoch.

As to the cave deposits—those of the countries bordering on the Mediterranean—which consist of a closely-packed mass of remains of the great Pleistocene mammalia, it is certain that no agency but that of water could have brought them and huddled them up together in such heaps at one spot. Lyell's explanation, however, seems to the Duke of Argyll to be very unsatisfactory. He does not conceive it possible that the animals fell into rivers and the latter into swallow-holes or subterranean passages, which, in time, became choked with the skeletons; but he does think it feasible that some movement of the earth's crust simultaneously opened swallow-holes, produced an inundation, and swept the animals from their haunts to the caves in which they are found. These caves and fissures so packed with bones are now almost universally dissociated and broken off from the old lines of drainage, and it is pertinently asked whether the dissociation may not have been contemporaneous with the inundation which swept the animals to their tomb. Let any man go even to the cave of Brixham, says the Duke of Argyll, and he will see at a glance that since that cave can have been the bed of a stream, as beyond all question it was very lately in geological time, the whole physical geography of that part of the earth's surface must have been entirely broken up and changed. Nothing but the bondage of an hypothesis which is not founded upon any sound philosophy could, he thinks, banish from our consideration the high probability of one simple explanation—that in very recent times great changes in the moulding of the earth's surface have occurred over a great part of Europe with sufficient rapidity to cause great destruction of animal life, and during the progress of the submergence to sweep the bodies of the drowned creatures into the fissures and swallow-holes which were opened or enlarged at the same time. If the Uniformitarian hypothesis were true, we ought to find caves and fissures containing remains from the Eocene and Miocene epochs. The accumulation of Pleistocene mammalian remains which forms the Dogger Bank may have been caused by the collection of the bodies in the eddies of a river, or by the sweep of a tidal wave; but the question is, if the first hypothesis is accepted, how came the rivers to be in such roaring flood, and the answer given by the Duke of Argyll is rather more agreeable with the supposition of a sudden irruption of a flood than with the slow and regular deposit of a river. How also can we account for the sudden destruction of the mammoth and its contemporaries, which are known to be preserved in countless thousands in the Tundras of Siberia, from the Gulf of Obi to Behring's

Straits, except by a catastrophe of the kind indicated above. In their case we must assume also that the carcases were frozen almost at the same time as they were engulfed—that there was an inundation, followed directly afterwards by a period of great cold, which has continued ever since. There has been no break in the continuity of physical causation; but the very continuity has apparently produced at intervals some very extensive and very violent changes in the configuration of sea and land. With regard to the remains which are supposed to indicate the remote antiquity of man—the flint implements of palæolithic type found beneath river gravels and fluviatile silts—the evidence is not conclusive; and it is disputed whether the beds have been really slowly deposited, for they are often found full of foreign matter— that is, not belonging to the drainage basin of the river with which they are connected. Thus the Duke of Argyll is enabled to say that many of the palæolithic implements have been found in gravels which cannot be assigned to existing rivers, but may, with a tolerable degree of certainty, be assigned to the same marine submergence which has piled heaps of gravel with dead shells on the top of Moel Trefyn and the hills above Macclesfield —a submergence so brief that time was not afforded for the establishment of molluscan and other forms of marine life. The Duke of Argyll thinks that this view of many of the problems of geology has not been worked out with even tolerable consistency; but now that he has called attention to it, it is not unlikely that some of the advocates of the Uniformitarian hypothesis will reply, and from the contention of rival theorists we may ultimately arrive at the truth.

RELATIONS OF STATIC AND DYNAMIC ELECTRICITY.

By JOHN T. SPRAGUE.

SOME time since I promised to explain a subject which has puzzled a good many, and as to which questions have often been put—viz., the often-quoted statement of Faraday as to the electricity contained in water and ~~in a~~ flash of lightning. That is the text of the present article.

Faraday said that the electricity contained in a grain of water is equal to that in a powerful flash of lightning: some quote him as saying it is equal to that of a severe thunderstorm. Now, we know from chemistry that the potential energy of a grain of water — that due to the combination of hydrogen and oxygen, which combination is broken up by electricity—is ft.-lb. 6,841 ÷ 9 = 760. It seems absurd, therefore, to compare this with the enormous forces exerted by lightning, seeing that it is hardly equal to raising the heat of a pound of water one degree Fahrenheit.

We must remember that when Faraday made this statement he was only beginning the study of electric quantities and relations, our present knowledge of which is largely due to his work. At that time nothing but vague generalities had been attained to, and little was known, or even imagined, as to the nature of electricity. Our present exact system of measurement was undreamed of, and Faraday was therefore unable to perceive that he was comparing together things having no relation such as he was working at; but it is strange that his statements should be constantly quoted as if they contained real truths, and that their true interpretation has not yet been clearly shown. Before attempting this it will be well to bring together the actual statements of Faraday and other workers on the same lines.

Faraday found that to decompose a grain of water required a current for three and three-quarter minutes capable of keeping red hot a platinum wire 1-104th of an inch in diameter. The very vagueness of such a measure at once shows the difficulties under which he laboured: we can express this value definitely as a current, for the time given, of 3·13 ampères; or, better still, as a "quantity" of 704·37 coulombs, the coulomb and ampère representing chemical action equal to ·000158grm. of hydrogen or ·00142 of water. He found that to effect the same decomposition by the machine required 800,000 charges of a Leyden battery of 15 jars, each of 184 square inches of coated surface. Each of these charges, produced by 30 turns of a 50in. plate machine was capable of killing a rat, and was equivalent, chemically, to the action of a platinum and zinc wire, each of 1-18th of an inch in diameter, dipping ⅝ths of an inch into 4oz. of water containing one drop of acid, and developing current for about three seconds. Weber has also calculated that this charge from one grain of water, if placed on a cloud 1,000 metres (3,281ft.) above the earth, would exert an attractive force equal to 1,497 tons. So we have this enormous force and the potential slaughter of nearly a million of rats, originating in water, which we know is only possessed of less than 800 foot-pounds of energy, just about the amount of work a man ought to do in every five minutes of his day's labour.

De la Rive says: "Becquerel succeeded in finding that in order to decompose a gramme (15·43 grains) of water a quantity of electricity was required, equivalent to what would be furnished by 51,586,400 discharges of a battery having one square metre (1·9609yds.) of surface, reduced to 20,063,456 when the charge of the battery is at its maximum. On reducing Faraday's result to the same conditions we find 21,830,451. The difference is very inconsiderable for experiments of this nature." This remark shows how very imperfect was the then existing knowledge. The value of the comparison depends wholly upon the potential given to the charge, not merely on the coated surfaces, and in the actual figures this shows a variation between 51 and 20 millions. He goes on to say, "Adopting the round number of 20,000,000 for 1 gramme, in order to decompose a milligramme (·0154 grain) of water there are required 20,000 discharges of a battery of 1 square metre surface, or an electric pane having a surface of about 5 acres (Faraday's figures give 352 acres). Now, it is this same quantity of electricity that must be produced by the decomposition of this same milligramme of water by chemical means; and if it were accumulated so as to discharge itself instantaneously, it would be capable of producing the effects of a flash of lightning."

Weber established the relation between the statical and dynamical effects of the charge of a Leyden jar by measuring the first with the torsion balance, and the other by means of a galvanometer, to which the charge passed as a current by means of a long column of water which it traversed. His results were as follows:—

"Through each section of a conductor traversed by a current whose force is equal to the electro-magnetic unit there passes, in a second of time a quantity of electricity equal to 155,370 × 10^6 static units, an equal quantity of negative electricity travelling in the opposite direction.

"The quantity of electricity required to decompose 1 milligramme of water amounts to 106⅔ times this quantity (this being the ratio of the electro-chemical to the electro-magnetic units) or 16,573 × 10^9 units of electricity of each kind; to decompose 9 milligrammes, or 1 equivalent, requires of course 9 times this quantity. This quantity of + electricity (9 × 16,573 × 10^9) accumulated on a cloud 1,000 metres above the surface of the earth, would exert an attractive force equal to 226,800 kilogrammes, or 208 tons."

It is further calculated that if all the atoms of hydrogen in 1 milligramme of water in the form of a column of 1 millimetre long were attached to a thread, and all the atoms of oxygen to another, then to effect the decomposition of the water in one second, the two threads would require to be drawn apart with a force of 147,380 kilogrammes, or 145 tons. The thread would need to be tolerably strong, seeing that this immeasurably exceeds the tensile strength of any known material; that is to say, this imaginary force, mathematically demonstrated, is greater than any cohesive force known to exist.

Now let us translate this into modern expressions. We have seen that the dynamic value of 1 grain of water is 704·37 coulombs. What is the corresponding static expression which will replace the 800,000 charges and 325 acres of coated pane? We require a condenser of capacity capable of receiving a charge of 704·37 coulombs, and the mere dimensions of this will depend upon the potential of the charge; starting with the unit 1 volt, and taking the capacity of the usual cable as 3·5 micro-farads per mile, we find that a force of 1 volt (say a Daniell cell) would require 2,465 million miles of cable to receive it, or speaking roughly, enough to wind 1,200 times round the earth and moon, or go twice round the orbit of the earth; that is to say, the earth would take two years in "paying it out."

Let us put it another way: the (imaginary) capacity of the earth is 630 millions of electro-static units, or 700 micro-farads; this quantity (throwing in the odd 4·37 millions) would charge to 1 volt a million such worlds as ours! or, allowing the potential which Messrs. Ayrton and Perry calculated as necessary for their theory of the earth's magnetism—viz., 54 million volts, it would only require 54 grains of water to supply the required electricity, which, however, Prof. Rowland also calculated would result in bursting the earth to pieces.

Leaving all these fantastic unrealities in which some people delight, let us examine the commonsense of the matter. Electricity is nothing but a word in which certain natural phenomena are embodied, and it involves two wholly distinct functions, both of which are commonly called "electricity"; for instance, people talk of the torrents of electricity poured forth in a flash of lightning, and the torrents of electricity streaming out of a dynamo machine, and the idea of "quantity" in these two is wholly different; each belongs to one of the two functions which together constitute electricity. Those two functions are (1), The molecular construction of *matter*—that to which the idea of the "grain of water" is collated, and which we may symbolise as Q, for quantity; (2), the stress put upon those molecules, the "potential" symbolised by E for electromotive force. Static electricity has no existence as a "quantity"; it is simply the evidence of the stress existing in that class of matter which is called dielectric, or which resists the passage of electric current. All the ideas we have been considering are based upon the impossible isolation of Q; the real phenomena always depend upon Q × E. Matter and energy together constitute electricity.

Now, in the case of water the E is a potential of volt 1·5, and what we have to take into account in the case of the grain of water is, therefore, 704 × 1·5 = 1,056, which multiplied by ·7373 gives us a little over the 760ft.-pounds, which we know is the total energy of the grain of water. Let us now consider the case of the lightning flash, the Q of which is this same 704 coulombs, or the grain of water. The E M F of the lightning flash is very uncertain; it is calculated from experiments with De la Rue's 14,000-cell battery, that the E M F of a flash one mile in length is 3,604,000 volts, and this by the same process gives us 1,872 millions of foot-pounds, and enables us to realise why this "grain of water" can produce such great effects when concentrating this amount of energy in some point of high resistance which appropriates great part of it as "work" in possibly one millionth of a second.

But the *current* of such a flash is not, as some say, a very small one, because current is Q ÷ T, related to time, and the ampère means 1 coulomb per second. We have here, then, 704 coulombs, passing in a time variously estimated as one 20,000th to 1 millionth of a second; taking the lowest estimate, we have a current of 14 million ampères, greater than all the dynamos on earth could generate. From this it is pretty clear that no lightning-conductor is ever called upon to carry such a current; either it lowers the potential so gradually that the actual flash when it occurs is reduced to a very small one, or, on the other hand, it only carries a small part of the energy of the discharge, which is largely distributed over surrounding space.

It should be clearly realised that the distinction of static and dynamic electricity is artificial and misleading as usually conceived. *Frictional* electricity differs from that of the battery only in being produced in a circuit of highly resisting substances, and therefore under high potential. But so-called *static* electricity has no existence at all; it is a name which includes either *stresses* set up in dielectrics—that is, actions of energy in an *inductive circuit*, or else of very small currents in a *conductive* circuit of great resistance, all dielectrics having some small conductive capacity.

The static phenomena are exactly parallel with the dynamic. It may be said that there is this difference: that an electric current requires a continual expenditure of energy to maintain it, while the static charge, once produced, may be (theoretically) maintained indefinitely without the expenditure of energy. The theory which says so is a mathematical one, commencing with the favourite formula, "Let us assume." That a charge can be so maintained is an assumption contradicted by every known fact. The fact that no such charge has ever been produced is explained, in order to fit the theory, by the invention of "leakage"; that is to say, there exists no such perfect dielectric as the theory requires for its foundation: all dielectrics are partial conductors, and this means *current*. But even if we imagine such a dielectric, it would involve, not static *electricity*, but energy, stored "potential," as strains upon the molecules of the dielectric; just as we have in the secondary battery, not electricity, but energy, stored potential as chemical forces. Further, no such charge could prove its existence as a charge. When it moves an indicator of any kind, that involves energy expended and current passing. The simple fact is, that the current is infinitesimal and the energy inappreciable. But we have just such currents in dynamic electricity. Experiments have been made as to deposit of minerals, in which the resistance of the depositing cell is so great, that the current would need a century to deposit one grain of metal, and yet that current can indicate itself upon a galvanometer. In such experiments the depositing cell is a static field, a condenser, in which only a small force exists. Its electrodes indicate a static charge, exactly as do the static conductors, and the electrolytic cell and static condenser are exact analogues of each other.

I think these relations are more clearly shown in a tabular form, which contrasts the two circuits and principles, than in any other manner, and therefore I append such a table, which I have prepared for my book

Static	ELECTRICITY	*Dynamic*
Energy *potential*: stored in a field of force, as stress in a dielectric.	means	Energy *kinetic*: acting in a conducting path, along molecular chains.
Inductive	CAPACITY	*Conductive*
Area of dielectric.	varies as	Area of conductor.
Spec. ind. capacity of dielectric.	"	Specific conductivity of material.
Thickness	inversely as	Length
Units of Charge stored under unit Potential.	is measured by	Units of Current transmitted under unit E M F.
The Potential in volts required for unit Charge.	or by	The E M F in Volts required for unit current.
Inductive	RESISTANCE	*Conductive*
Reciprocal of inductive capacity.	is the	Reciprocal of conducting capacity.
CHARGE	ELECTRIC	CURRENT
Potential, in volts.	is as	Electromotive force, in volts.
Resistance.	inversely as	Resistance.
Lines of force under stress.	is related to and dependent on	Lines of equivalent molecules forming chains.
Inversely as the several resistances.	divides among several circuits	Inversely as the several resistances.
	ENERGY, OR WORK.	
Square of charge in unit or equal resistance.	is as	Square of current in unit or equal resistance.
	FORMULÆ.	
Charge $\frac{E}{R} = Q$	Current	$\frac{E}{R} = C$
Potential $Q \times R = E$	Electromotive force	$C \times R = E$
Resistance $\frac{E}{Q} = R$	Resistance	$\frac{E}{C} = R$

NEW METHOD OF MANUFACTURING BICHROMATE OF SODA.

BICHROMATE of soda is, we believe, unknown as a commercial salt, but if it can be produced in a pure state by any process not more expensive than that employed for obtaining the corresponding salt of potassium, there is a wide field of usefulness for it, as it is a more powerful oxidiser than the bichromate of potash, and should be cheaper. Messrs. Potter and Higgin, of Bolton, have recently obtained letters patent for an "improved process of manufacturing bichromate of soda," which is thus described: The chrome ore is furnaced with lime or carbonate of lime and a suitable sodium salt, preferably the sulphate, using in some cases a certain proportion of the recovered sodium sulphate. The furnacing is done in substantially the same manner as in the potassium bichromate manufacture, where lime and sulphate of potash are used. The resulting material is lixiviated with water in the ordinary manner, and the liquor obtained is treated with hydrochloric or other acid, in such quantity as to exactly neutralise it; other acids may be used, but hydrochloric is much preferred to sulphuric or any other. On neutralisation the silica and alumina are precipitated, and carefully removed by settling and filtration. The neutralised and purified liquor is then concentrated in under-fired pans of suitable construction, and, as the boiling solution loses its water, the chloride and residual sulphate of soda contained therein are thrown out in the crystalline form, while the chromates of soda remain in solution. The crystals are removed by mechanical means, either by ordinary hand fishing, or by other means, and after draining are washed with neutralised vat liquor, before concentration. This liquor containing a considerable quantity of these salts already fails to dissolve them, but being far from saturated with chromates takes up nearly all the latter. The washings resulting are then concentrated as above, and practically little or no neutralised liquor will go straight to the pan, but will all previously be used to wash salts. It will thus be seen that the action is an accumulating one, by which gradually all the chromates are left in solution in the pan, and all other salts are obtained in a washed state nearly free from chromates. When sulphuric acid has been used to neutralise the vat liquor, these washed fished salts containing a trace of chromates are then used again, after drying, in place of an equivalent quantity of fresh salt cake. But when hydrochloric acid is used to neutralise the vat liquor, then the washed fished salts, which consist in this case mainly of sodium chloride with traces of chromates, are converted into sulphates by the ordinary salt cake process, and then used again in place of an equivalent quantity of fresh salt cake, thus recovering and utilising the last remaining chromium compounds.

The strong solution remaining in the pan is filtered, or otherwise freed from the last crystals of chloride and sulphate of soda floating in it, and is then boiled down to dryness and the salt perfectly dried (but not fused) in a top-fired mechanical pan, or by other means, care being taken to keep the temperature low and an excess of oxygen always in the gases in contact with the bichrome salt. The bichromate of soda obtained by this process contains monochromate, but as the reactions of the salts are identical this is of no importance. In cases, however, where a pure specimen of bichromate is wanted for a special purpose, the neutralised and purified vat liquor is, after removal of alumina and silica, treated with a further quantity of acid (preferably hydrochloric) in exactly the quantity required to convert the whole of the monochromate salt into bichromate, as calculated from analysis of the vat liquor before treatment with acid, and the process is then conducted as above, but in this case the pans used would have to be of special material, to avoid contaminating the acid liquor, for which purpose lead would probably be the most suitable.

In practice, however, the manufacture of the pure salt is not so advantageous as an impure article composed of about two-thirds of bichromate and one-third monochromate, with a very small but variable quantity of neutral salts of soda, and at this point it has a neutral reaction and the same amount of oxidising power as the potassium salt, and can consequently be substituted for it in whole or in part in equal quantities, weight for weight. The patentees give reasons why no one has hitherto succeeded in manufacturing commercially useful bichromate of soda, but as their process is successful we give it for what it may be worth. They claim the process as a whole, and certain specified operations.

PRACTICAL NOTES ON PLUMBING.—LXXXIV.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 187.)

Equilibrium Ball-Valves.

THERE are various kinds of equilibrium ball valves: some are very simple, whilst others are of a most complicated class, and often without any advantage. For my part, I thoroughly indorse the words which Mr. Muir, the engineer to the New River waterworks, once said to me, when in course of conversation about which kind of ball valves were the best to adopt. His words were: "I like your ball valve for the simple reason that with it you have only one chance of leakage, whereas in most others of this class there are two openings"; meaning that with the class of ball valve, Fig. 401, &c., there is a chance of leakage at B, and also at A J.

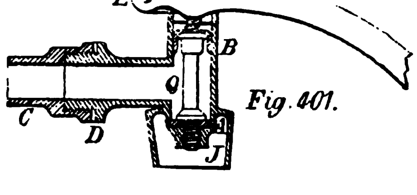

Fig. 401.

The Fig. 401 represents the ball valve known as Lambert's patent, and which has for many years been made public property. It is, on account of its price and simplicity, very extensively used, and consists of a cup leather at B, working within a truly-bored cylinder. On the top cup leather is a slotted guide for guiding the cup leather and spindle, and for keeping the valve perpendicular with the valve-seating, and for actuating the valve and cup leather; it also serves for the rod F to pass through, and to be fulcrumed, as shown at E. The action is as follows:—On depressing the lever F, the cup leather and valve J descends from the seating, when of course the water is allowed to run past the seating Now let the ball float and rise. This will actuate the valve and so bring it up to press against the water, and finally against the seating, and the water will be shut off. At the same time that the water is pressing against the valve so it is against the underside of the cup leather, which tends to push upwards, and by reason of the cup leather and valve with the spindle being so coupled together so that as the water tends to force the valve away, so it does the cup leather, and as the size of the seating is, or should be, of the same bore as the cylinder of the cup leather, so will the force of the water be equalised, and the whole weight of the two be held in equilibrio upon the connecting spindle of the value and cup leather. In this valve as now made there exists a great evil, and one which may be very easily rectified, at least, in the larger sizes. It consists of the usually very narrow space round the sides of the valve and the outlet A of the valve seating. Here the dirt, &c., accumulates, and cannot wash away, but if this space were, at least, ⅜in. to ½in. clear, then this valve would have a better chance to work, and the dirt, &c., to pass away. Caution: When taking this valve out for repairs, &c., be careful not to force the cup leather back with main force, as it will catch in the water way Q, and thereby get its edges cut and spoilt. When it is found to hang, try and push it back with the end of the pliers, &c., or unscrew the valve off the spindle, and take the cup-leather the other way, then, when out, take a sharp-edged reamer, or better, a small ripper (a brassfinisher's lathe tool), and ream away the sharp edges round the edge of the inlet water-way Q; then the cup-leather will freely pass in either direction.

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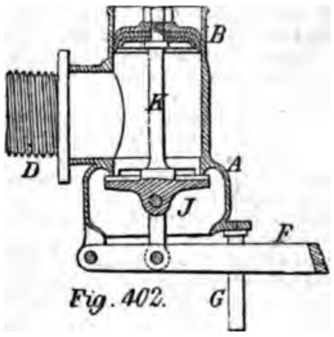


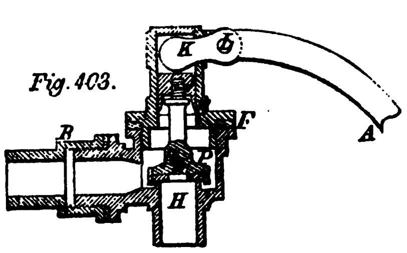
Fig. 402.

Fig. 402 is the same kind of valve, but worked from below, as at E G.

Ball Valves to Close with the Stream.

For this kind of valve, see Fig. 403. This valve has its seating set inward, and the valve is allowed to work quite clear, and to leave the waterway fully open and free, which is not the case in Figs. 301 and 302; besides this, there is another good feature in this valve. The valve lifting upwards allows any small pieces of dirt and stone to pass freely, and therefore is not so likely to be put out of order by such substances. There is one evil in this ball valve. By reason of its closing with the stream, it is apt to be pulled up too suddenly, and so cause a great concussion in the pipes, as in the hydraulic ram, though this act of inadvertence would not happen with careful men, and, as a rule, this valve works exceedingly well.

Fig. 403.



Movable Tube Seating Equilibrium Valves.

Th's valve, Fig. 404, is made by Guest and *Chrimes, also by Messrs. Stone* and Co., and other well-known brass finishers, and will be readily understood. E is the tube, having a seating formed on its upper edge, and which shuts against the rubber D. Round the side of this sliding tube is fixed a cup leather F, which prevents the water from passing the sides of the tube and valve. The action is as follows:—On lowering the lever I, it being coupled to the tube at L, it takes down the tube when the seating comes below the fixed rubber, and the water is allowed to run down the tube and out at K. Sometimes the valve D is made in such a manner that it is free to move upwards, and can be carried upon the tube seating, which, by reason of its upward movement will prevent the rubber from being cut should the lever be pulled up too high; but on its descent it cannot follow the tube past a certain mark, which is shown by the shoulder R. For repairing this valve unscrew the top C, and take out the valve D, and insert the new rubber *of the same thickness*. This valve, as far as being proof against the effects of dirt, &c., is very good, and may be considered a true equilibrium.

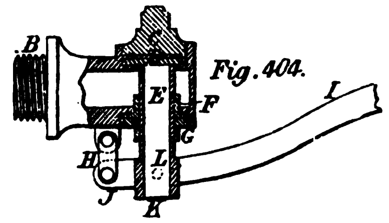
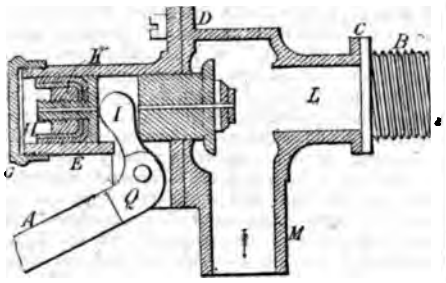


Fig. 404.

Horizontal Ball Valves.

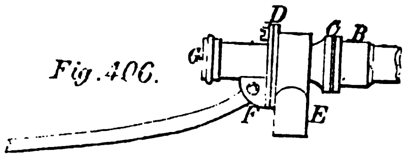
These ball valves *when properly made*, are exceedingly good, and when the valve is made to open its proper width and the body large enough round the outlet of the valve seating L, Fig. 405, the grit, lead shavings, &c, can be washed out, and will fall direct through the outlet. This valve is balanced by the pressure of water being allowed to pass through a small hole drilled up the spindle, and allowed to get at the end as shown at H, Fig. 405, where it is prevented from passing out by the cap G, and from getting between the sides by the cup leather K. To repair this valve, simply unscrew the flange F and re-rubber the valve. The cup leather, *in the best made valves*, can be removed by taking out the small screw Q, and allowing the spindle to fall out.

Fig. 405.



Some makers make the spindle in such a manner that it will not admit of being so easily taken out. When such is the case, a forked screwdriver must be employed to turn the cup leather nut off; then the cup leather can be taken off and the spindle withdrawn, of course providing the lever is unscrewed, &c. Fig. 406 is an elevation of this valve, which will at sight enable my readers at once to select this class of valve.

Fig. 406.



I may say that the varieties of ball valves are legion: some are made to work with cup leathers, some with pistons, and some with diaphragms. But what I have endeavoured to do in this, my work, is to place before my readers those which are universally used, and by all competent judges accepted as being the simplest and the most serviceable for the many different pressures which the plumber has to work against.

My experience, which is close on 30 years practical work under nearly all the different large water companies in England, and some in America, teaches me that of all ball valves in the market there are none to equal those represented at Figs. 405 and 406 *when properly balanced and made*. I write these words in italics knowing it to be a fact, that many makers are to be found making these valves who do not understand their business, nor even the principle on which the valve works.

(*To be continued*)

HOW TO MAKE A CHEAP LATHE.—II.*

The Framework.

NOW, our patterns being at the founder's, we will take advantage of the opportunity thus afforded to make the standards and bed. With reference to the choice of wood for the bed, a word or two will not be out of place here. An iron bed suitable for a lathe of this size would, when cast and planed, cost between two or three pounds—a considerable item. It may, certainly, by a vast expenditure of precious time, be filed up truly, in which case the only outlay incurred is the price of the rough casting and the necessary files. But for the ordinary run of home work, a wooden bed is quite as useful as an iron one, and the lathe I am describing is very much superior to the average specimens of such wood turners' lathes as I have seen. For wood turning alone it is suited admirably, and it is also, if properly made, rigid enough to permit of the use of a slide rest in light metal work.

But if an iron bed should in some cases be deemed more desirable, it might even then be preferable to make a wooden bed in the first place, and at some subsequent period to transfer the poppets to the metal bed, for which they are equally well adapted; the gratification of using the lathe would not be so long delayed, and the filing of the iron bed could proceed at leisure intervals.

In the selection of the most suitable wood, let us choose between oak, beech, or birch for the bed, and birch, pitch pine, or red deal for the standards, taking that which is most easily procurable. Say we fix on red deal quartering for the latter and oak for the former. Two 14ft. lengths of 3in. by 2in. quartering, quite sound, will be required for the standards. The oak, so small in quantity, had better be bought at a carpenter's shop, instead of at a timber yard, in order to secure a bit of old stuff; for oak, if not thoroughly seasoned, will become warped very badly after a few months' exposure of the grain.

For the standards we require two frames like Fig. 10. Prepare four pieces (two for each frame) finished to 3ft. by 3in. by 2in., Fig. 11, A A for the sides. Two pieces, 2ft. by 3in. by 2in., B for the bottom. Four pieces, 1ft. 2¼in. by 3in. by 2in., C C for the cross bars. Mark and cut mortises and tenons to dimensions indicated (Fig. 11).

Shall we presume that all who read this article know exactly how to make mortise and tenon joints? Scarcely so, perhaps. Mortises and tenons, then, are marked with a mortise gauge, that is, a gauge having two cutters instead of one only, as in the ordinary marking gauge, the lower cutter of the two, as well as the head, being capable of adjustment independently of each other. The amout of separation of the two cutters being adjusted to the required thickness of the tenon, the head of the gauge is set in such a position that on being slid along the edge of the wood, the tenon is marked at its proper distance from the face. The same gauge is used for the mortise also.

Here our tenons will be ¾in. thick. and in the centre of the stuff. So the cutters will be set to ¾in. by the screw at the end of the stem, and the face of the head ⅝in. away from the nearest cutter. If we don't possess a mortise gauge we must use a marking gauge instead, and take a little more time over the job. In either case, mark the tenons, and cut down their faces, keeping just a shade outside the lines, with a fine tises on the underside of the back rail, and in the standards. One end only of each diagonal can be fixed at first. Let that be the end attached to the standard. When both diagonals are thus fixed, bring the back rail down on the free ends, and secure with a stout screw, in addition to the glued and mortised joint.

The tool board and rack would only be in the way if we made them now; and as our castings are come home from the founder, we shall prefer to leave the remaining odds and ends of woodwork for the present, and commence fitting up.

Two 14ft. lengths of quartering at 2d. per foot run = 4s. 8d.; two pieces of dry oak—almost a favour to get—say 2s. each, 8s. 8d. Ten shillings, then, will cover the cost of timber, including the three stretcher strips.

THE DIALYTE TELESCOPE.—II.

By W. Bradbury.

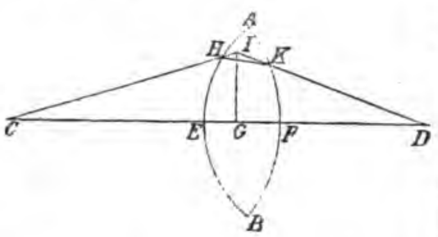
BY the use of formulæ similar to Mr. Beverly's I have computed the following curves for an instrument made with Chance's glass:—

Hard crown object-glass, aperture 4in. clear.
Focus 60in. Equi-convex, each radius 61·2.
Correctors, hard crown and dense flint, aperture 2in. clear.

Focus of each lens, 10in.
Crown lens, biconvex, radii .. 7·7, 15·2
Flint lens, bi-concave, radii .. 15·2, 10·45
Correctors 30in. behind object-glass.

It must be observed that these calculations take into consideration central aberration only; hence it must not be expected that the curves they furnish will be altogether the best. In the dialyte there is evidently a complication of errors, which will probably yield to no formulæ. But one of these imperfections must be noticed—viz., distortion, which may be regarded as a compound species of aberration. Coddington has given formulæ, whereby it may be eliminated, but the process is far too complicated to be reproduced here; however, the main parts may be dealt with in a very simple manner.

Thus supposing we have a single convex lens A B, and the rays from an object at C are converged by it to the point D. Then we say the magnitude of the images are as their distances from the lens—that is, as b is to c, if we call E C and F D, b and c respectively. Now the tangents of the angles H C E and K D F are nearly in the inverse ratio of b to c. They would be so exactly, if the points H and K were equally distant from the axis; but this is not the case. Produce C H and D K to intersect in I, and drop G I square to C D; call angles H C E and K D F, x and y respectively. Then the ratio of the tangents is accurately as G D to G C. That is:—



$$\frac{\tan. x}{\tan. y} = \frac{GD}{GC}$$

Now it is evident that the points G and D are both variable: the first depends on the intersection of the incident and emergent lines; and the second is affected by the spherical aberration. Hence, we must seek so to divide the refraction between the two surfaces, that the joint effect of these two variations may disturb the ratio of the tangents as little as possible. Or, we may say, that ratio of surfaces is the best which gives the ratio of the tangents nearest to $b : c$. So that if

$$\frac{\tan. y}{\tan. x} = \frac{GC}{GD} = \frac{b}{c}\left\{ I + V \right\}$$

we require a lens which shall make the value of V the smallest possible.

In the ordinary object-glass, it is unnecessary to take into account the effect of distortion, *because* the ratio of focal length to aperture is too great to allow eccentric refraction to show any evil effect beyond the ordinary spherical error. But in the dialyte this is otherwise. Even if distortion is not developed by the objective, it must be by the correctors.

With regard to a single lens, Coddington has shown that the best effect is obtained from it by making the surfaces as 9 to 19, or say as 1 to 2; and even with an equi-convex, the factor V is very little increased. Passing on to the separated combination, we cannot do better than follow the same author in the results he has deduced for the Huyghenian eyepiece.

In a combination proportioned as—foci 3 to 1; separation 2—he gives the following values for V with different sets of lenses:—

1st lens, equi-convex; 2nd, convexo-plane, $V = \frac{3}{108}$.
1st „ plano-convex; 2nd, equi-convex, $V = -\frac{9}{108}$.
Both lenses pla.-convex, or convexo-plane, $V = \frac{18}{108}$.

From these it is plain that the first combination gives the least outstanding error; and although the dialyte is not exactly similar to the negative eyepiece, yet there is a great similarity between the two, so that we shall probably not be wrong in assuming that the best arrangement for the former will work well in the latter. The dialyte pair of correctors are generally of equal and opposite foci, which causes their joint effect to be nearly imperceptible. We may consider them as resembling the second lens of the negative eyepiece divided into a positive and a negative part. And evidently if we make the positive part a convexo-plane lens, its counterpart should be a plano-concave, so that their plane sides (or they may have a very shallow curvature) shall come together.

These considerations confirm the correctness of the plan followed by Professor L. Smith.

We must next investigate the proportion of foci necessary for the production of achromatism. Let F and f be respectively the foci of the crown and flint lenses; d, the dispersive power of the crown glass and D that of the flint. Then d/D is the ratio of dispersive powers, generally denoted by δ, and is always less than unity. With the same glass, the amount of dispersion is inversely as the lens' focal length—that is, in a pair of crown lenses, as $d/F : d/F'$. Now if two lenses, crown and flint, achromatise, they must each give the same amount of dispersion in opposite directions; or, we must have $d/F = D/f$: this is generally expressed by saying that the foci must be directly as the repective dispersive powers. If there are several lenses of either kind in contact, the same equation must still be fulfilled, remembering that F and f in that case represent the united powers of each system of lenses. Thus, for two crown and one flint lens we have:—

$$d\left(\frac{1}{F} + \frac{1}{F'}\right) = \frac{D}{f}$$

and suppose F' and f are of equal but opposite foci. Then we get eventually:

$$\frac{F}{f} = \frac{\delta}{1 - \delta}$$

This would give a triple combination something like the dialyte lenses, but requiring the three to be close together.

Next, we will assume that a crown and flint pair are so arranged as to be achromatic when separated by a distance s: to find the proportion of foci necessary. Evidently the effect is the same as if we had a crown lens of the shortened focus $(F - s)$, but with an amount of dispersion equal to that of the whole focus F. Let us find the dispersion due to the reduced focus. Representing it by d', we have:—

$$\frac{1}{F} : \frac{1}{(F - s)} :: d : d'. \text{ or } d' = \frac{F\,d}{(F - s)}.$$

And since this is sufficient to balance the negative action of the flint lens, the following equation is satisfied:—

$$(F - s) : f :: \frac{F\,d}{(F - s)} : D$$

Or, if we substitute δ for d/D, we get—

$$f = \frac{(F - s)^2}{F . \delta}.$$

From this any one value may be found when the other three are known. The value of F is—

$$F = s + \frac{f\delta}{2} \pm \tfrac{1}{2}\sqrt{f\delta\,(4s + f\delta)}.$$

The reduced focus is a mean proportional between the flint and the crown focus multiplied by δ, and if A = acting semi-aperture of crown, a that of flint lens, we have—

$$\frac{F}{f} = \frac{A^2}{a^2} . \delta .$$

Hence, when δ is constant, the foci will vary directly as the squares of the semi-apertures. To apply the formula to a triplet arrangement of two crown and one flint lenses, the second and third in contact, but removed apart from the first, we must substitute $F / (F - s)^2$ for F in the equation for a multiple combination. Then we get—

$$d\left(\frac{F}{(F - s)^2} + \frac{1}{F^1}\right) = \frac{D}{f}$$
$$\text{or } \left(\frac{F}{(F - s)^2} + \frac{1}{F^1}\right) = \frac{1}{f\delta}.$$

And if A and a are the acting semi apertures, the second and third lenses being supposed of equal size—

$$\frac{1}{F} = \frac{a^2}{A^2}\left(\frac{1}{f\delta} - \frac{1}{F^1}\right) \text{ or } F = \frac{A^2}{a^2}\left(\frac{F^1 f\delta}{F^1 - f\delta}\right).$$

If it be a condition that the second and third lenses are equal but opposite in focal lengths, F¹ disappears from the equation, and it becomes—

$$F = \frac{A^2}{a^2} . \frac{f\delta}{1 - \delta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (a)\,8$$

To find F independent of the semi-aperture, we have—

$$F = s + \tfrac{1}{2} . \frac{f\delta}{1 - \delta} \pm \frac{\sqrt{f\delta\,[4s\,(1 - \delta) + f\delta]}}{2\,(1 - \delta)}.*$$

Equation (a) is the ordinary formula for proportioning the foci of the lenses of a dialyte; and though not absolutely correct, as indeed are any of the simple proportions for achromatic foci, yet it gives in an easy manner a near approximation. This is sufficient in an instrument which is designed to furnish within itself the necessary adjustment for elimination of residual errors.

It does not seem probable that anything more than central correction can be obtained from the ratio of focal lengths. Eccentric chromatic refraction will necessarily show itself when the correcting compound lens exerts its effect away from the source of error. A meniscus objective appears better suited for causing less lenticular chromatism than a double convex; but whether an apparent advantage in this way might not be more than counterbalanced by a difficulty in surmounting spheric errors, is a point that can only be decided by practical construction.

Considerable corrective power appears to lie in the form or disposition of the lenses of the eyepiece. Both Mr. Wray and Professor Smith allude to the obtrusiveness of eccentric chromatism; the former says this was corrected by a peculiar form of eyepiece; the latter gets rid of it by rearranging the positions of the eyepiece lenses. We are not told in what the peculiarity of the eyepiece consisted; but the fact that it can be overcome by a particular construction shows that the imperfection is not so serious as many might anticipate. Professor Smith says, "It is necessary to separate the lenses of the eyepiece considerably, to insure correction throughout the whole field."

This is a very simple way of improving the achromatism, and one which anyone can adopt with very little trouble. It is not easy to see why an increase of separation should have a corrective action on the marginal chromatism; but in the passage of coloured rays through an arrangement of small lenses, many minute changes are induced which can only be judged of by their final effect. The negative eyepiece is chromatically undercorrect, which is obvious from the fact that the field lens would disperse the white ray into red, and blue rays, the former behind the latter; and in this position they are unsuitable for transmission to the eyelens. Hence, it would seem old universities, that they are acting in harmony with examples afforded by classic times, and in obedience to present national necessities. There is, however, one thing about all these competitions which does not produce unmixed satisfaction, and that is that all cannot win. There must be those who are first and those who are second or third and those who are last, and naturally enough the losers feel more or less disappointed. But all who try to win and fail are nevertheless gainers. Though they do not gain all they desired or expected, they gain something. The poet says, and says truly—' 'Tis better to have loved and lost, than never to have loved at all.' A dozen boys may run or jump, and though only one may win, all strengthen their muscles and develop their frames. So it is with the candidates for the Cambridge and Oxford Local Examinations. A few get prizes; a few others get certificates or honourable mention; but all get the reward granted to honourable endeavour. I would therefore say to the successful 'be not too elated,' and to the unsuccessful 'be not cast down.' The first school song I ever heard, or at all events the first I remember, had this refrain—'if at first you don't succeed, try, try, try again.' If you have not succeeded to the measure of your expectations you may succeed better next year or the year following; but, whether you win prizes or lose them, you will be better to the end of your lives for the trial. I cannot conclude these few observations without again referring to the benefit of universal education. Education is essential to the individual citizen and the State. It is essential on account of the position we occupy, the advantages we inherit, and the national and international duties we have undertaken. There is and there will be an increasing demand for educated men and women to keep our industries going, and to maintain our institutions and our national life. And I regard these local examinations as amongst the necessary means to develop the mind and character of our people, and I trust that they will meet with abundant success and thereby increase the educational wealth of the country, and at the same time shed an additional lustre on those ancient seats of learning—the Universities of Oxford and Cambridge."

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* It may be observed that both in this and a preceding similar formula, since s is the amount of separation, $\frac{f\delta}{2}$ and $\frac{f\delta}{2(1 - \delta)}$ = half the focus of a crown which would produce achromatism in contact with the flint; the quantity under the vinculum which remains to make up the value of F, will approach to the value of $\frac{f\delta}{2}$ and $\frac{f\delta}{2(1 - \delta)}$ as s diminishes, and if $s = o$, then $F = \frac{f\delta}{1 - \delta}$ as before shown.

THE TRANSMISSION OF ENERGY.

III.*

By Prof. Osborne Reynolds, M.A., F.R.S.

(*Concluded from p.* 191.)

SO far I have spoken only of the conveyance of power by means of coal, corn, or in one or other of the several forms of packed energy. To-night I come to consider the transmission of power by what are more distinctly mechanical methods, and by currents along pipes and conductors. These are the means by which power is almost always distributed, *i.e.*, transmitted from the acting agent, be it horse, water-wheel, or steam-engine, to its operation, whatever it may be. In most cases the distance of such transmission is so short as to be the subject of small consideration in determining the means to be employed. That is to say, the means are chosen rather by their adaptability to receive and render up the power than by the efficiency with which they transmit it. Thus, if we take an ordinary mill, the shaft which receives the power from the engine is generally driven at that speed which is best adapted to receive the power from the engine, and deliver it to the machinery in the mill, without considering whether a much smaller shaft might be used if it were caused to run at a much higher speed. Thus, in a mill driven by an engine of two or three hundred horse-power, the shaft which receives the power will generally be 5in or 6in. in diameter, whereas it would be possible to use a shaft of 2in diameter if the efficiency of the shaft were the only consideration.

My object is to show the limits within which the use of each means is confined, however fit it may be for its purpose. Taking first the mechanical means, which are shafts and ropes, we find that the possible limits to both these means are absolutely defined by the strength of material. The amount of power any piece of material will transmit by motion against resistance, is simply the mean product of the stress or force acting in the direction of motion on the section, multiplied by the velocity, so that, if the stress is uniform over the section, the work is the product of the area and intensity of stress and the velocity.

In a revolving shaft, nither the stress nor the velocity are uniform over the section, both varying uniformly from nothing in the middle to their greatest value on the outside; so that their mean product is exactly half the product of the greatest values. The greatest power per square unit of section a shaft can transmit is half the product of the greatest stress into the velocity at the outside of *the shaft.*

Taking, then, the greatest safe working stress for steel at 15,000lb. on the square inch; taking what is the greatest practical velocity at the surface, 10ft. per second (the speed of railway journals); the work transmitted is 75,000 foot-pounds per second per square inch of section—135 h.p.; so that we should have to have a shaft of upwards of 7 sq. in. in section to transmit 1,000 h.p., that is, a shaft of over 3in. diameter. The friction between such a shaft and lubricated bearings is well-known, ·04; so that, calculating the weight of the shaft 24lb. per foot, we have power spent in friction about 52,000 foot-pounds per mile, that is one-tenth the total power the shaft will transmit. That is, if we put 1,000 h.p. into a 3in. shaft, making 500 revolutions per minute, we ought, at the end of a mile, to be able to take 900 h.p. out of it. If we had to go farther, the size of the shaft might be diminished so that in the next mile we should again lose a tenth, and if we repeat this process seven times, we shall, at the end of seven miles, have left about half the original power put in.

It would be thought, perhaps, that a 3in. shaft is very small to transmit so large a force: this is because the speed of 500 revolutions per minute is inconveniently high for purposes of employing the power; but if it were merely a question of transmission, it would be about the best speed. This, then, shows the limit of the capacity of shafts as transmitters of work.

Turning now to steel ropes, these have a great advantage over shafts, for the stress on the section will be uniform, the velocity will be uniform, and may be at least ten to fifteen times as great as with shafts—say 100ft. per second; the rope is carried on friction pulleys, which may be at distances of 500ft. or 600ft., so that the coefficient of friction will not be more than ·015, instead of ·04. Taking all this into account, and turning to actual results, the work transmitted per inch would be 1,500,000 foot-pounds per second; or that a ¾in. rope is all that is necessary to transmit 1,000 h.p. in one direction: this would make the loss per mile only 1-50th. But in practice, rope has to be worked backwards and forwards, and the tension in the backward portion of the rope must be half the tension in the forward portion. This reduces the performance from 1-60th to 1-20th, which would cause half the work to be lost in 10 miles. If we use a bigger rope, and run at lower speed, then the coefficient of friction would be reduced to 0·1, and the distance extend to 15 miles.

Experience with ropes is large, and they have been found, without question, to have been the most efficient mechanical means of transmitting power to long distances, but their use is subject to drawbacks. The ropes wear somewhat rapidly, as do also the pulleys on which they run, and this circumstance is very much against their use in any permanent work. Nevertheless, they are used for working mines, steep inclines, and steam ploughs; while at Schaffhausen they have been used for transmitting power to considerable distances.

Turning to the transmission of power along pipes, we find the conditions somewhat modified. The formula for the amount of power transmitted by water is the same, namely, the product of the area of section into the velocity. But the resistance obeys different laws. In the case of shafts and ropes, we have seen that the distance is subject to an absolute limit.

In the case of fluid in pipes this is not so. No matter how long a pipe may be, if there is no leakage, water would flow along the pipe until the level of its surface were the same at both ends. But the rate of flow would diminish with the length and diameter of the pipe. Thus we can transmit power through a perfectly tight pipe, however small, and however long; but when we come to consider the gross power that can be transmitted through a given pipe, with a given per-centage of loss, the question is different. Given the size and strength of the pipe, the gross amount of power, and the percentage of loss, and the limits are fixed. Thus, taking a 12in. pipe capable of standing 1,400lb. on the square inch, the loss in transmitting 1,000 h.p. would be about 5 per cent. per mile, at first increasing—as the pressure fell to 700lb.—to 10 per cent. We should thus have lost half the power in about seven miles. We cannot say that seven miles is the absolute limit, for with a 24in. pipe which would cost four times as much per mile, we could transmit the same power thirty times as far with the same loss. The cost of laying a 12in. pipe for seven miles, however, would probably be as much as even 1,000 h.p. would stand; while a 24in. pipe for 200 miles would be out of all proportion. Then there is the consideration of leakage, which, although very small for short lengths, is larger for greater lengths.

Seven miles is at present an outside economical limit of hydraulic transmission, even for such a large amount of power: but with air the case is different. This flows so much easier than water, that the cost of transmitting the same power through the same distance, with the same loss, would be about 12 per cent., or, at the same cost per mile, the air may be transmitted 100 times as far with the same loss. The total cost, however, would thus be 100 times as great, which would exceed the economical limit; but not only theory but practice has shown that power may be economically transmitted five times as far by air as by water—something like thirty miles. But on comparing these two means, one circumstance must not be lost sight of, and that is, that getting the power into the pipe in the form of compressed air, will cost twice as much as getting it in in the form of water. This is a great advantage for water where the distance is short; but where the distance is long, the greater efficiency of air more than compensates for this initial loss.

Like water, air can only be transmitted economically where the quantity is large, the friction being proportionately greater in small pipes than in large, varying as the four-fifths power of the diameter. This is a great drawback, both as regards hydraulic and compressed air transmission. It does not affect ropes and shafts in the same way, but even in these cases considerations of durability prevent these means being used efficiently for the transmission of small quantities of power to considerable distances, so that, with the possibility already mentioned, there remains an opening for any means that will enable power to be transmitted efficiently in small quantities, and such a means we have in the flow of electricity along wires or conductors. In considering electricity, we may well start with the questions—1. Will electricity enable us to transmit power in large quantities more efficiently than the foregoing means? 2. Will it enable us to transmit small quantities? These questions may be more definitely answered than they could a few weeks ago. Thanks to the experiments of M. Deprez, who appears to have been the only one, out of all those who are advocating the use of electricity, who has had the courage to try and see what can be done, we can now say with certainty that a current of electricity, equivalent to 5 h.p., may be sent along a telegraph wire 1-6 of an inch in diameter, some ten miles long (there and back) with an expenditure of 29 per cent. of the power, because this has already been done. In order to do this, it would seem that M. Deprez has perfected his apparatus so as to have nearly reached the possible limit. Compared with wire rope, this means falls short in actual efficiency, as Messrs. Hems send 500 h.p. along a ¾in. rope. To carry this amount, as in the experiment of Deprez, one hundred telegraph wires would be required; these wound into a rope would make it more than 1·4in. in diameter, four times the weight of Mr. Hems's rope. With the moving rope the loss per mile is only 1·4 per cent., while with the electricity it was nearly 6; so that, as regards weight of conductor and efficiency, the electric transmission is far inferior to the flying rope. Nor is this all. With the flying belt, Mr. Hems found the loss at the ends, in getting the power into and out of the rope, 2½ per cent.; whereas, in M. Deprez's experiment, 30 per cent. was lost in the electric machinery alone, which is very small as such machinery goes. But this is not all. No account is here taken of the loss of power in the transmission to and from the electric machinery—a matter which is, I believe, very much under-estimated.

The machines made revolutions at 1,000 and 700, much too high for direct connection with either a steam-engine or any mechanical operator; the power, then, had at each end to be transmitted through gearing, or a system of belts. And supposing this alteration of speed to have been five or six at each end, experience tells us that a loss of at least 15 per cent. must ensue. This loss was indeed apparent, for the dynamometer was connected with the machine with a belt, which showed a loss from this one belt alone of 20 per cent. Taking the whole result, it does not appear that more than 15 or 20 per cent. of the work done by the steam-engine could have been applied to any mechanical operation at the other end of the line, as against 90 per cent., which might have been realised with wire rope transmission. To set off against this, electricity has the enormous advantage in the conductor being fixed, and in the fact that it is likely to be, if anything, less costly and more efficient for small quantities of power than for large. These advantages will certainly insure a very large use for electricity in the distribution of power, particularly for high speed machinery.

There is yet another means of communicating and distributing energy now coming rapidly into vogue. This is by the transmission of coal gas along pipes. The distances, often many miles, through which the gas is often transmitted before reaching the engine, are such that, with any other means of distributing power, would considerably enhance the cost of the power. But in the case of gas, it does not appear that these distances are at all a matter of consideration. This may be at once explained. It takes about ten cubic feet of gas to develop 1,000,000 foot-pounds in a gas-engine, whereas of air compressed in the ordinary way it would require something like 140 cubic feet to yield the same power. Hence the comparative cost of transmission is the cost of transmitting ten cubic feet of gas against that of 140 cubic feet of compressed air, and these would be about as one to tion to the subject, and remarks that the quantity of catechu to be used necessarily varies according to the properties of the feed-water. He considers, however, that the placing of the catechu on the plate immediately over the fire is neither suitable nor requisite. His experience in removing incrustations already formed extends mostly to cases where the thickness was ¼in. to ⅜in., and by a carefully following out of his receipt, he maintains that the incrustation soon becomes detached and floats in the water in pieces about the size of a half-crown.

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* *Abstracted from the Cantor Lectures, delivered before the Society of Arts.*

The catechu at first makes the water of a deep red colour—as may be noticed by the gauge glass—and if this shade is not produced a further quantity of catechu must be added. In a few days the dissolving of the incrustation will have been complete. At this time—or in any case before the water has changed from deep red to bright red—the boiler is put out of action and is cleansed from the incrustation, now lying in free pieces, as well as from dust, &c., and is filled again as usual with water. This cleaning out of the boiler some days after the first addition of the catechu is absolutely necessary, for as soon as the catechu is saturated with the incrustation the sinking of the floating pieces causes the recommencement of incrustation in various parts of the boiler. It is therefore suggested to postpone the adding of catechu until eight or ten days before the cleansing of the boiler, care being taken that a sufficient quantity of catechu be added during that period.

According to Herr Hiller's theory, the introduction of a quantity of catechu when the boiler is being filled again is not advisable, as the consequent thickening of the water is apt to cause stoppage of taps, &c. He considers the catechu ought to be added to the feed-water when it is hot. Some pounds of catechu should be placed in a strong drill bag, which should be fastened in such a way as to be covered by the feed-water, the catechu being thus dissolved. If the sack is empty before the water is of a deep red colour, more catechu should be added, the bag being cleaned out first. When the required deep red tinge is attained, the addition of catechu ceases, but is resumed if the water loses that shade, or else the consequences may be serious. Should it be desired to give up the use of catechu, it should not be broken off at once, but should be continued until the next boiler-cleaning takes place, and then ceased.

There are some descriptions of water which, though not containing the substances which usually form incrustations, have other kinds of impurities. Against these catechu is of no effect.

The cleaning of boilers where catechu is used has to be more frequent, though less troublesome, than when such is not the case, on account of the increasing substance thickening the water. The saving of the boiler itself is considered, however, to make up for this circumstance, and for the relative high cost of the substance used. A powder has, it is remarked, been for some time in use in which catechu is employed in union with other chemical substances.—*The Engineer*.

[The right to prepare and sell the catechu referred to is said to be the subject matter of letters patent granted in 1874 in the United Kingdom, which patent is still in force.—Ed.]

USEFUL AND SCIENTIFIC NOTES.

White Fillings for Teeth.—There are several white fillings in use by dental surgeons which contain neither mercury nor silver. They are made by mixing oxide of zinc with impalpable glass-powder in small proportion; and just before using, when the cavity of the tooth is prepared, a small quantity of deliquesced chloride of zinc is placed on a glass slab, and enough powder added to make a thick paste, mixed rapidly. It "sets" very quickly, and forms a good temporary stopping. It is slightly irritating to the "nerve" of a tooth, and should not be inserted directly into a cavity in which caries has far advanced without placing a little solution of guttapercha in chloroform over the region of the pulp. A less irritating filling is made by mixing the same powder of oxide of zinc with pyrophosphoric acid; this is a more permanent white stopping.

A VINEYARD proprietor near Nimes having had several complaints made to him about his wines, requested M. Barthélemy, Professor of the Faculty of Sciences at Toulouse, to analyse them for him. In some of them a rather large proportion of arsenic was found, larger than the trace sometimes found in certain red wines. The wine from one barrel tested contained no arsenic at all, and in this instance the cask containing the wine was a new one; it had not been previously used. The other barrels had been cleaned after use with "drogue," which, in point of fact, is diluted sulphuric acid, and the sulphuric acid of the central districts of France has of late years contained so much arsenic that M. Barthélemy has sometimes used it to obtain *a supply of that material.*

SCIENTIFIC NEWS.

THE famous red star which M. Trouvelot saw for a moment near the sun during the total eclipse of May 6th last is now recognised as, without doubt, Alpha Arietis—at least, Prof. Krüger, of the *Astronomische Nachrichten*, says that he has a communication from Prof. Holden which practically settles the question, and the intra-Mercurial planet is once more undiscovered.

Dr. Palisa's small planet 226, discovered at Vienna on July 19, 1882, has been named Weringia.

The anniversary meeting of the Royal Society will be held as usual on St. Andrew's Day, Nov. 30, when the following names will be submitted for election as officers and council:—President, Prof. T. H. Huxley, LL.D.; Treasurer, J. Evans, D.C.L., LL.D.; Secretaries, Prof. G. G. Stokes, M.A., D.C.L., LL.D.; Prof. M. Foster, M.A., M.D.; Foreign Secretary, Prof. A. W. Williamson, LL.D.; other members of the Council—Capt. W. Abney, R.E., Prof. W. G. Adams, M.A., F.C.P.S.; the Duke of Argyll, K.T., D.C.L., J. G. Baker, F.L.S., T. L. Brunton, M.D., Sc.D., W. H. M. Christie, Astronomer Royal, W. De la Rue, M.A., D.C.L., Sir F. J. O. Evans, K.C.B., Prof. G. C. Foster, B.A., F. Galton, M.A., F.G.S., J. W. L. Glaisher, M.A., Sir W. W. Gull, M.D., H. Müller, Ph.D., Prof. J. Prestwich, M.A., F.G.S., Prof. O. Reynolds, M.A., O. Salvin, M.A., F.L.S.

The death is announced of Prof. P. T. Riess, the well-known physicist. He was the first Jew admitted into the Prussian Academy of Sciences, being chosen in 1842.

The death is also announced of M. Louis Bréguet, the famous horologist of Paris. He was a distinguished mechanician and electrician, and contributed many important papers to the Bureau des Longitudes. He was born Dec. 22, 1804.

The telegraph wire to the summit of Ben Nevis has been completed; and as Mr. Omond will by the time this reaches our readers have settled himself in his post, those who wish can have telegraphic messages as to the state of the weather at the highest point in Great Britain.

At a quarterly meeting of the Institution of Mechanical Engineers, held last week at Birmingham, an interesting paper by Mr. E. A. Cowper was read, in which the author described the inventions of James Watt and his models preserved at Handsworth and South Kensington. Mr. Cowper gives a list of 34 models which he describes, and points out the improvements which have followed on the inventions of Watt. This paper, when published, will be useful to many, for as there is no explanation appended to the models, it is necessary to carefully examine them in order to read their meaning.

The Institute of Civil Engineers have arranged for a series of lectures on Heat and its Mechanical Applications during six alternate Thursday evenings. The lecture on Nov. 15 will be "The General Theory of Thermodynamics," by Prof. Reynolds, F.R.S. On Dec. 6 "The Generation of Steam and the Thermodynamic Principles Involved," by Mr. Anderson. On Jan. 17, 1884, "The Steam Engine," by Mr. E. A. Cowper. On Feb. 24, "Gas and Caloric Engines," by Prof. Fleeming Jenkin, F.R.S. On March 20, "Compressed Air and other Refrigerating Machinery," by Mr. A. C. Kirk, and on April 3rd "Heat Action and Explosives," by Capt. A. Noble, F.R.S.

In opening the class of engineering in Edinburgh last week, Prof. Fleeming Jenkin delivered a lecture on Telpherage, in the course of which he said it would provide the cheapest mode of inland conveyance for small quantities of goods, and might enable explorers to reach the North Pole. We will give an account of the system shortly.

The electric light was, last week, employed with much satisfaction and success in the operating room of the Royal Ophthalmic Hospital, Moorfields. The "light" was a platinum wire incandescent burner in a metal case, with a lens in front and a reflector behind it. The battery was a four-celled bichromate. The "light" was affixed to a movable stand, which could be carried about and held in any desired position by an assistant.

According to experiments made by Professor Pulny, of the Ecole Polytechnique of Vienna, incandescent lamps fed by alternating current machines, have a longer life than those fed by direct currents. It has been known for some time that with direct currents there is a transference of carbon to the negative side of the filament, and if the direction is changed at regular but comparatively long intervals, the top of the filament increases in size. With alternating currents it is found that the filament preserves its form and thickness for a very long time, but slowly becomes more slender at the bend.

A series of ten lectures on the diseases of field and garden crops, will be delivered by Mr. W. G. Smith, F.L.S., before the Institute of Agriculture, at South Kensington (British Museum), during next week. The lectures will be fully illustrated.

One of Mr. Webb's compound locomotives recently took a train of thirteen coaches from Euston to Carlisle, ascending the Shap Fell inclines without assistance. The weather was "greasy," the time 7h. 20m., less 32m. for stops at stations. A run of 300 miles at that speed is not a bad performance for a "complicated" machine.

The "diffusion pulp" from the beet sugar factories has been largely used on the Continent as a food for cows. According to MM. Andouard and Dezounay, it does not deserve its reputation as a milk-producing food. Their experiments, however, were made with pulp which had been preserved in a silo. Given to a cow in quantities of 60lb. and then 120lb. a day, there was an immediate augmentation of 32 per cent. in the yield of milk; the richness in casein and mineral salts did not appear to be affected, the proportion of butter was increased 12½, and of sugar 23½ per cent.; but children refused the milk on account of its flavour, and the experimenters doubt whether good-flavoured butter could be made from it.

We regret to record the death on Oct. 26, at Southsea, of the Rev. Nathaniel Stedman Godfrey, S.C.L., F.R.A.S., for twenty-five years vicar of St. Bartholomew's, Southsea, and for many years an esteemed contributor to these pages, aged 66. We have also to record the death of another contributor, Captain James Steel, late quartermaster in the Royal Engineers, which took place at his residence, Glenalvon-villa, the Avenue, Southampton, on Monday week. Captain Steel joined the Royal Sappers and Miners in September, 1839, and on account of his great taste for the investigation of scientific questions, combined with mathematical abilities of no mean order, he was promoted by the late General Sir Charles Pasley, R.E., then commandant of the Royal Engineers' establishment at Chatham. Having passed through the junior grades, this worthy regimental non-commissioned officer was promoted to sergeant-major, on the 6th October, 1854, and performed the duties so as to earn the respect of both officers and men, until the 24th of October, 1863, when he was commissioned as quartermaster. Quartermaster Steel retired from the Royal Engineers on half-pay in November, 1873, and was appointed manager of the Ordnance Map Depot in London, an appointment which he held with much credit, until he resigned it about six years ago. In addition to Captain Steel's scientific attainments, he was an ardent musician and a proficient on the violin.

The Otto Engine and Dowson Gas.—We understand that Messrs. Crossley Brothers have recently made a further test of the fuel consumption with the Dowson gas at their new works at Openshaw, and that the following is the result:—During 17 days there was an average of 90 (indicated) horse-power, and 8 tons of coal were used, the fuel consumption being as low as 1·3lb., per indicated horse-power per hour, although the power was produced by several engines.

ACCORDING to a communication made to the London section of the Society of Chemical Industry, by Mr. W. Weldon, F.R.S., it does not seem that we are much nearer to cheap aluminium than we have been for a long time. A short time since it was announced that a new method of production had been invented and was in use; but Mr. Weldon says this invention only relates to the production of anhydrous alumina from potash alum, and if the method of obtaining this were 50 per cent. cheaper than that of M. Pechiney, of Salindres, it would only cheapen aluminium by 5 per cent.

taking into account the p.m. of A deduced from meridian observations at Dorpat and Poulkova, he finds the movement of B rectilinear, and due to the p.m. of A. He remarks, however, that on this hypothesis it is difficult to understand how, unless the small star be variable, it should have been missed in 1857 and 1858, as the distance then would be considerably larger than in 1872, when the measures were made without any trouble; for, according to his formulæ, the minimum distance was reached in 1871·3, and the stars ought then to begin to separate.

M. Perrotin has recently measured this curious object with the 15in. equatorial by MM. Henry at Nice: he gives 198·9°: 2·39″: 1883·6 (4 nights). Strange to say, he sees a fainter star, 11·3 mag., with *exactly* the same position angle, the distance being only 1·44″. If this star really exists, Σ. 2400 is one of the most remarkable triples known. Perrotin suggests that some of O. Σ.'s observations may refer to this new star, and not to Σ.'s companion. O. Σ.'s observations, when he failed to see or only suspected Σ.'s *comes*, were made with a power of 858 on the 15in. refractor. It is to be hoped that this interesting object will not be neglected in future.

Oct. 31st. **H. S.**

β DELPHINI, δ EQUULEI.

[22014.]—Since writing my last letter (21988) I have had two opportunities of measuring β Delphini. They were nights on which there was a great deal of fog, and the definition was exceptionally good—the finest I have had this year. But in a short time the fog thickened so much as entirely to cover up the sky and put an end to work.

The measurements were as follows:—

β Delphini. R.A. 20·31. Mags. 4·3, 5·7.
P = 193·0°. D = 0·3″ (est.) Ep. 1880·826.
P = 192·0°. D = 0·3″ (est.) Ep. 1880·829.

In a star of such difficulty, however, there may well be an error of 10° in the angle; but I believe it to be not far off the mark.

I tried δ Equulei the same night; but could not be sure that it was double.

Jevon J. Muschamp Perry.
St. Paul's Vicarage, Alnwick.

A CHEAP ADAPTED PYROLOGICAL HAND-BLOWER.

[22015.]—Accustomed as I am now to see our native English ingenuity and talent employed in adapting instruments and apparatus, well known and cheaply sold in connection with other and more ordinary uses, to the purposes of blowpipe analysis, it has not yet been my lot to come across such a simple and ingenious adaptation as this by Mr. J. T. Letcher, of Truro, Cornwall.

It is, in few words, the conversion of one of those white, vulcanite, children's air-balls, about the diameter of one's closed fist, sold in toyshops for 3d. or 4d. each, into a *blowpipe hand-blower* (!), and a very efficient one Mr. Letcher has made of it.

Although, of course, such a blower would not be expected to possess the power of leather bellows, the return of the elastic ball to a spherical shape after squeezing (which creates the atmospheric indraught) being by no means so vigorous as the outwards force of a contained steel spring, or the muscular pulling open of hand (housemaid's) leather bellows, and consequently the pressure of indrawn air and then of expelled air being proportionately less; still, for ordinary purposes of blowpipe analysis—as e.g., the sublimation of volatile metals on aluminium plate, &c.,—this cheap and most ingenious little hand-blower is really first-class.

The valves are placed in two small turned pieces of boxwood inserted into the poles of the little elastic air-globe, and an elastic air-reservoir, covered by a hair net, is situated about halfway in a piece of vulcanised rubber tubing leading to the telescopic stand for the jet and nozzle, which are moved up, down, or sideways on a kind of universal joint, this stand being also, I believe, an invention of Mr. Letcher.

That gentleman has also sent me a most ingenious telescopic-stand holder for platinum wire, &c., and for Al plate on a pinch, though the grasp of the geometrical pen is scarcely long enough for that; but I have doubled this length by boring another hole for the screw nearly at the base of the pen "arm."

Mr. Letcher has also been so good as to send me a most beautifully-finished air-reservoir blowpipe, with platinum jet (Fig. 3, "Easy Lessons, &c.," Vol. XXXVII. p. 163, "E. M."), which, with his other apparatus, I shall have the pleasure and pride of showing in France, Italy, Switzerland, and Germany, on my sojourn there shortly, as specimens of the work of an English "Bergmechanikus," as Plattner calls Lingke ("Probirkunst," &c., p. 32).

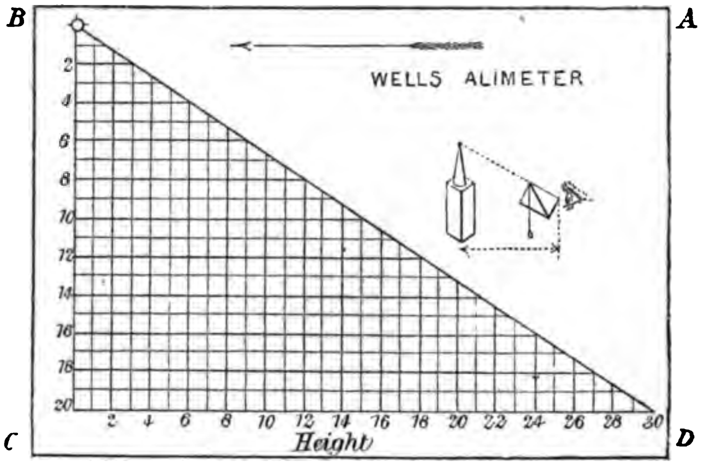
W. A. Ross.

AN INSTRUMENT FOR ROUGH ESTIMATION OF HEIGHT OF BUILDINGS, &c.

[22016.]—I have lately seen an ingenious application of the properties of similar triangles, which seems worthy of a place in your paper.

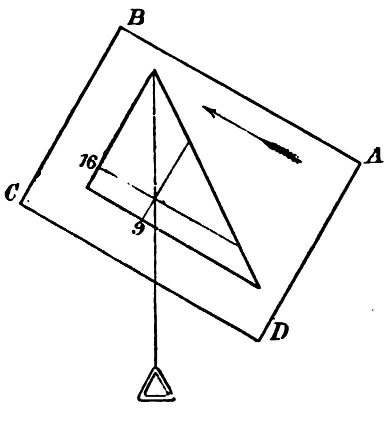
If Fig. 1 is cut out and pasted on cardboard, it will answer for measuring heights up to 30 yards. Make a fine hole exactly at the corner of the triangle near B, and pass a silk thread through it. Fasten with a knot behind, and attach a light weight, such as a wire ring, at about 4in. from the hole, at the other end of thread. This is to act as a plumb line.

Fig. 1.



To use it to measure a house, for instance:—Stand at a convenient distance, say, 16 yards from it, and look along the top edge A B at the point of which you wish to ascertain the height. The silk thread will now hang as in Fig. 2.

Fig. 2.



Look along the line on B C marked 16 yards, and the point at which the plumb line cuts it indicates the height of the top of the building measured from the level of your eye. Add to this the distance from your eye to the ground, say, 5ft. 6in.

Thus the height of the building, as indicated in Fig. 2, is 9 yards, or 27ft. Adding 5ft. 6in., gives 32ft. 6in. as the total height.

In measuring the horizontal distance (in this case assumed to be 16 yards) from the building to the observer, a point vertically beneath that to be "sighted" must be taken to measure from. Instead of reading the divisions as yards, they may be read as feet.

It is best to stand at a distance about equal to the height to be measured. For this purpose, B C should be made as long as C D; but space forbids my making it so in the figure.

I have been told that it was invented by a Mr. Wells, a gardener under Sir J. Paxton.

Glatton.

RAILWAY SPEEDS.

[22017.]—With reference to the letter of your correspondent "St. Aubyn's" (letter 21970, p. 175), asking for details as to the journey of "three hours exactly" between Leeds and King's-cross, by the Duke of Edinburgh's special, I inclose you an extract from a note received by me this morning from Mr. Cockshott, superintendent of the line for the Great Northern. Mr. Cockshott says:—

"We have not at any time run a train from Leeds to King's-cross in three hours. H.R.H. the Duke of Edinburgh has not travelled on our line from Leeds to King's-cross for a considerable time."

The origin of this extravagant report consists in the fact that on June 24th, 1882, the Prince of *Wales* was conveyed from *Bradford* to King's-cross (193 miles) in 3h. 48m., including a stoppage of 5 minutes at Grantham (as I was informed at the time in a letter from Mr. Cockshott).

At the meeting of the British Association in Southampton during the last week of August, 1882, Mr. John Fowler, doubtless alluding to the above run, stated that "a few months ago the Duke of Edinburgh was taken from Leeds to London, a distance of 186¾ miles, in exactly three hours."

The wish, however, must have been father to the thought, for according to the superintendent of the line himself, such a run never did take place. When such a thing does occur, it will no doubt be on the Great Northern.

In the mean time, I think that however interesting these "parade" runs may be, it is of much more practical importance to know what is the ordinary average of the speed attained, as a matter of course, every day of the year by our express trains.

In a few weeks I hope to have published a little pamphlet containing details of speed, gradients, &c., for all the express lines in the kingdom.

Cambridge, Oct. 31. **E. Foxwell.**

THE AUTOMATIC VACUUM BRAKE.

[22018.]—May I draw the attention of your readers to another danger of the automatic vacuum brake in use on the Midland Railway. A fortnight ago, two men were fined at Leicester for leaving a train in motion. From the statements of passengers in the train, and also of people on the platform, it appears that the brake leaked off, after the train had come to a stop. This allowed the buffer-springs to recoil, and move the carriages, and three persons were thrown down in leaving the train. At a previous station a passenger had been thrown down in exactly the same manner. Surely some strong measures should be taken to compel the company to remedy this state of affairs. Not only are trains constantly running past danger signals, and into buffer stops; but here is a case of passengers being thrown down owing to the use of a dangerous appliance, which allows the power to leak away when it is urgently required. The drivers are punished for jerking the trains. This is most unjust, as it is not their fault. Some months ago, inspectors were sent round to inquire into these cases of "jerking" the trains. When the drivers asked to be shown how to remedy this, the answer was something to this effect: "You must use your own judgment; I have not come here to show you how it is to be done, but to tell you that it has to be done." No answer could show more clearly that those who ought to know do not know how to use this appliance—an appliance supposed to be for the safety of passengers and servants.

This jerk is due—firstly, to the more powerful steam brake stopping the engine (to which it is fitted) more quickly than the train, which causes the impetus of the train to compress the buffer springs; and secondly, to the leaking off of the brake on the carriages, allowing the buffer springs to rebound.

This compression of the buffer springs shows the want of power of the vacuum brake. Couplings are often broken owing to the use of a powerful steam brake on the engine in conjunction with a weak vacuum brake on the carriages. On July 13, the 11.10 a.m. train Leeds to Bradford (engine 158), was stopped by the application of the brake by the guard. Since the steam brake cannot be applied by the guard, the motion of the engine was not arrested, and the tender coupling was broken. On Oct. 10, a coupling was again broken on the 6.22 p.m. Leeds to Skipton, at Armley, owing to the rebound of the carriages. On Oct. 25, 1.30 p.m., Leeds to Morecambe, coupling broken at Saltaire, from same cause—3 mins. delay.

Another source of danger has lately come under my notice. Engine "waste" has by some means entered the hosepipe and stopped it up. On Friday, September 28th, the 9.30 a.m. Bradford to Skipton ran past Frizinghall station owing to this cause, *although the vacuum gauge on the engine showed 20in., thus indicating that all was right.* On Saturday, September 29th, 7.30 a.m. Bradford to Ingleton ran past Manningham from the same cause, the gauge showing 20in. On the same day, the 11.20 a.m. Bradford to Keighley ran past Manningham from same cause. The remarkable point is, that in all these cases the gauge showed the drivers that the brake was in perfect working order, and yet when the brake was wanted there was none.

The ejectors can also prove a danger to the drivers. On June 29th, the 12.33 p.m. Keighley to Bradford was delayed 10 minutes at Shipley. The nut of the spindle attached to the ejector handle blew off inside, allowing the ejector handle to come completely out. The steam from the boiler issued through the hole, and the driver had a very narrow escape from being scalded. The train was in motion at the time (having just started), but the brakes were *not* applied automatically. Cases have also occurred in which drivers have been burnt by the flames issuing from the fire owing to the use of the large ejectors.

I think the majority of your readers will agree with me in saying that this brake is a most dangerous appliance, and ought not to be allowed to be used any longer. **Meteor.**

THE ACCIDENTS AT RETFORD AND BRINNINGTON JUNCTION, AND CONTINUOUS BRAKES.

[22019.]—On the 24th of August a collision occurred at Retford, on the Manchester, Sheffield, and Lincolnshire Railway, between a Great Northern passenger train and part of a coal train.

Major Marindin reports: "Great responsibility is incurred by the Company in leaving a passenger line of such importance running through a busy goods yards without the ordinary safety appliances of interlocked points and signals, and without the protection of block-working, which would have prevented the accident in this case."

The Great Northern passenger train was fitted with Smith's vacuum brake, and in the Board of Trade return the Company states that it *can* be applied by the guards; in actual practice it seems that in the present case the guard had no control over this brake. The engine-driver does not appear to have been aware that the line was blocked until too late; but the guard saw the home signal at danger when probably 500 yards away from it, and Major Marindin states: "If he had had the power of applying the continuous brake, which is a most essential condition for a proper brake, he would probably have been able to stop the train *and avert the collision.*"

Colonel Rich has presented his report upon the double collision which occurred on the 12th September near Brinnington junction on the Cheshire Lines (Joint) Railway.

An excursion train, from Doncaster to Liverpool and Chester, broke loose when running between Bredbury and Brinnington Junctions (near Stockport), and the leading portion of the train was twice run into by the rear portion (fourteen passengers being injured). The line is on an incline of 1 in 63 and 1 in 80.

The passenger train consisted of two engines and tenders, and nineteen vehicles, all fitted with Smith's vacuum brake, but the vacuum brake-pipe was not extended to the front of the second engine. The train was stopped at Bredbury by signals and the brake was in good order; but immediately after passing the starting signal the driver of the second engine observed that the indicator on his vacuum-gauge showed that the brake was out of order. It is a well-known fact that the vacuum brake is slow in action, and therefore causes severe [illegible] worked upon a long train; and from where the broken drawbar was pick[illegible] be no doubt that it was broken wh[illegible] checked at the Bredbury signal.

Colonel Rich reports: "If the [illegible] had been of an automatic kind, the [illegible] probably, have been prevented, applying itself to the rear portion of the train as soon as the brake-pipe was broken."

The general report upon the accidents which occurred during the year 1882 has recently been published, and contains a long list of cases in which accidents might have been avoided by efficient brakes, and also details of several which were caused by the failure or unsatisfactory working of vacuum brakes.

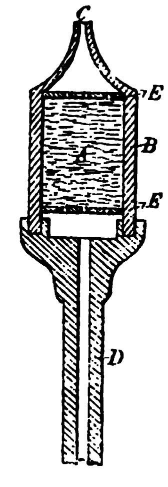
Mr. Calcraft states that the reports show "that no system of working, however complete in itself, can be considered satisfactory or as fully providing for safety which does not comprise the fitting of passenger trains with continuous brakes upon the conditions indicated by the Board of Trade." It must be remembered that the conditions above referred to were laid down more than six years ago, yet we still find the brake question in the present very unsatisfactory state. It is perfectly clear that certain companies never will adopt good brakes until compelled to do so. Under these circumstances it is clearly the duty of Parliament and the Board of Trade to protect the lives of the passengers by enforcing the adoption of safety appliances.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Nov. 3.

LANTERN MATTERS.

[22020.]—Having received so many valuable hints from "ours," I hasten to give what I believe will be of use to *all* who use the lantern. My troubles began in slide painting in making a sufficiently fine outline; and this is how I overcame this difficulty, and hit upon a plan at once as good, if not better, than that given by Mr. Dallinger some time since of drawing on ground glass with a pencil:—I first hunted up an old round table; this I painted a dead black colour, smoothing it off with sandpaper and filling up all cracks; then another coat of black, with plenty of turps in and a few pinches of vermilion to take off any tendency to blue in the paint. When thoroughly hardened, you have a circular blackboard, upon which you may sketch your intended outline. With a white chalk crayon, work as many fine outlines as you think proper. I then from this took a negative with an instantograph, using the 3¼in. by 3¼in. prepared "lantern dry plates" of Lancaster, giving about five seconds in dull weather, and developed until the black table began to show the merest trace of darkening; then I worked off and fixed and dried. I then had a most beautiful outline of the subject I wished, and done in *one fourth* the time it would have taken me to draw on the glass direct, and far better, and shows beautifully on the screen. Any amount of detail can be quickly done on the round black board, with the positive assurance that it will show well when magnified.



A. Asbestos fibre chamber.
B. Brass tube.
C. Nipple.
D. Pipe from dissolver to gas bag.
E. Perforated brass to contain the asbestos in place.

While thinking over the various lights in use, I remembered being told, at a certain lecture at which I was present, that only one gasbag was used, and in that bag were two gases mixed in their explosive proportions, and yet the audience were not blown to "smithereens." I unfortunately did not learn what kind of burner was used, and beg [illegible] our experts whether a burner could [illegible] this purpose (gases mixed in [illegible] as follows:—From [illegible] and the light [illegible] devised of [illegible] experts, and so always enjoy our 450-candle power light with no danger. And if this is feasible, let us by all means know size required for chamber and size of nipple hole, as well as number of feet required in one gasbag to hold both gases for, say, *one hour's* consumption.

March. **James Green.**

COLOURING LANTERN PHOTOGRAPHS.

[22021.]—Perhaps other amateurs besides myself have been discouraged at the difficulty of colouring smoothly the skies of lantern photographs. Having failed in getting results to please myself by dabbing, stroking, and many other dodges, I have now succeeded in getting perfect gradation of tone by pouring on a filtered solution of colour, previously ground up with "medium," in an agate mortar. Pour it on very dark at the top of the picture and flow it down to the horizon, then back again slowly, and allow it to drain off at the edge; when the proper depth is attained, blotting off the drainings from the edge; when dry, the outline of the horizon is easily obtained sharp by rubbing off the paint which has run over the border with a fine paper stump. Should any dust settle in spite of all precaution, I make my clouds at the faulty part, thus getting rid of specks. This may be, after all, a well-known dodge; if so, I apologise for intruding it in "ours."

Clapton. **Gerard Smith, M.R.C.S.**

GRINDING AND POLISHING GLASS SPECULA.

[22022.]—I would here call attention to a little error that has escaped my notice. In my last letter, Vol. XXXVII., p. 600, line 23 from bottom, "shadow" should be "shadows." As to Fig. 1 on the same page, though reduced in size from the one I sent, it is plenty large enough to use a scale upon to make the triangles by for any sized speculum. As to Fig. 2, the wood engraver has omitted to represent the pitch at the corners of the triangles seen in section, which pitch I refer to in p. 601, as shown in Fig. 2.

I now go on from where I left off in my last letter. I there supposed the amateur had his speculum rough ground, and fixed in the machine ready to begin with the elutriated emery. I may here observe that "elutriated" is a much better term than "washed," washing being only the process of removing the mud and dirt from the used emery. I forgot to mention that for rough grinding, 60 hole emery is the best size up to 8in. diam., above that, 40 hole is best, 60 and 40 hole meaning respectively emery that has been passed through sieves with 60 and 40 holes to the inch (in length). I must now tell the amateur how to get his elutriated emeries, and how to use them. As my object is not to go over again what others have explained before in our columns for years, I would refer the amateur to what I believe to be the best description of truing and smoothing, and an excellent mode of elutriating his emery in our obliging and always practical friend "Prismatique's" letters, Vol. XXXIV., pages 187 and 304. I believe almost everyone who practises the work will have his own little modifications of the general mode of doing it, and, of course, everyone thinks his modification is the best. I will, therefore, give some general observations and practical hints on this part of the subject. The amateur who has worked out the hollow of his speculum, and edged it, will, if he has carefully collected all the emery with a sponge into one vessel of water into which he keeps washing his sponge, have enough worked emery to collect all his six sizes of elutriated emery form, this number being enough for his purpose. If he lets the emery settle for three hours or more, and then pours off the water down to the emery, he will have what is technically called "sludge," and it is from this sludge that the trade gets all its grades of truing and smoothing emeries—they never buy it. But as some amateurs may not be able to get enough from their first sludge, "Prismatique" has kindly told me that I may here tell them that they can get 1lb. of what is called "washed" emery for 4s., from Medway's, Lloyd's-row, St. John's-street-road, London. From this emery the amateur can get all the grades he wants as "Prismatique" directs in his letters before referred to. Now, as there is very little wanted, I think the amateur may try to get all he wants from his own sludge, which, by the way, will continually accumulate with each speculum he makes, as in the trade. Now, one important thing in elutriating emery is to have plenty of water, especially for the amateur, when his sludge has accumulated, and there is another source of error to those who have plenty of sludge. It is the accumulation of mud with the emery, which will prevent the emery from going down in the time given for each grade. This mud is the ground glass and the metal of which the tool is made, and very fine emery. It is highly important, then, that the amateur commence the elutriations with com[illegible]tively clean sludge; to clean his sludge he [illegible] have plenty of water. I may almost say the more the better. I will give him what I consider the least safe limit for him—those used to it may use less. A teacupful of sludge, when dried, will weigh about 7oz., and will still about fill the cup. I have tried this experiment on purpose to have a handy means of judging for the amateur. Of course, to anyone who has practised for years, he can guess near enough; in fact, he gets to do all without much thought, and without any measuring; but I find, when I attempt to describe a process, simple as it may be to me, it does not do to say to an amateur, "put a little of this and plenty of that together, mix them for a short time, and then let them stand for a long time before pouring." I have to suppose the amateur is only learning, and has no experience to lead him to understand what a "little of this and plenty of that, &c.," means, as to quantity or time. I, therefore, have to descend to details that, to those who are farther advanced, may seem trivial and quite self-evident. I must confess that to write these letters is far more trouble than to do the whole thing. Well I have just said a teacupful of sludge weighs about 7oz.; now two teacupfuls of sludge, or say 1lb. of dry emery to each gallon of water, will be enough for washing the mud from the sludge, more water would do no harm, would be better in fact. Now for the washing: I will give my way: the amateur must have a sieve of 60 meshes to the inch, it must be brass, so as not to rust; he must pass his sludge through this. It is useful to press the sieve half way into the water below, so as to open the holes and half fill the sieve, then tap the sieve and let the sludge run through, what will be left on the sieve will have to be thrown away as of no value; of course, I have supposed he has roughed out with 60-hole emery, as I am by supposition dealing with a 6in. speculum. If he roughed out with 40-hole emery he must pass what is left through a 40-hole sieve, and thus save the unbroken down emery that would not pass through the 60-hole sieve; then throw what remains away, which will be bits of sponge and bits of glass and dirt of all kinds. Now for getting rid of the mud: the amateur must stir up all the sludge that has passed through the 60-hole sieve in plenty of water, not less than a gallon for every two teacupfuls of sludge, or say 1lb of dry emery, let it stand for 3 hours, then pour off all the water down to the emery at the bottom, but not to pour any of the emery away. This will carry off a lot of dirty, yellowish-brown mud. Repeat this, filling up with clean water three or four times, or until, as "Prismatique" says, the sludge, when stirred up, is of a chocolate colour. I always let stand three hours; and "Prismatique" corroborates this, and says: "Three hours will settle the finest emery when standing; but if the sides of the vessel be tapped the whole of the time, so as to cause a series of wavelets on the surface, the mud may be drawn off the finest emery in an hour." "Prismatique" further warns that great care must be taken, or perhaps much of the finest emery may be poured away and lost. This I proved to my sorrow once by letting stand only one hour (without tapping all the time), and I lost nearly all my No. 6 emery. I think, therefore, the amateur had better be on the safe side, and let stand three hours in plenty of water, and pour away.

I will now suppose the sludge is tolerably clean from mud. The amateur has now to divide his sludge into six grades in the following way:—He must have not less than one gallon of water to every pound of emery (those who are accustomed to the work may use less, but I recommend this as a safe proportion for an amateur); he must first get out the 60-hole emery, as this is altogether too coarse for truing. This I do by stirring up the sludge in the water, but not with a rotary motion, and tapping the sides of the vessel for three seconds; then quickly, though steadily, pouring off right down to the 60-hole emery, which will be seen to be at the bottom, with a little more, not quite so coarse, emery. All this I collect and put with the 60-hole emery for roughing purposes again. I repeat this into the first vessel (cleaned) back again, after which I find my sludge is clean from the coarse emery. We must now commence the dividing of the sludge into the 6-grades. I give below the times of subsidence used by Dr. Draper, "Prismatique," and myself; the times I use are a modification of what I believe the late Andrew Ross recommended:—

	Seconds.			Minutes.			
Dr. Draper..	3	20	60	3	10	30	60
Prismatique..	3	10	30	2		5	15
H. A. W. ..	3	10	35	2¼	7	20	60

It will be observed that each series begins with 3 seconds; this I take is really to get the coarse emery out. "Prismatique's" No. 6 is deposited in 15m., because of the tapping all the time, which helps to throw down the fine emery, and so takes a shorter time, so that there is not much difference between my No. 6 and "Prismatique's" No. 6, mine being only a little finer; his No. 4 is what is left of the bought fine or "washed" emery. It will be observed that the time for any particular emery is about three times the previous time used, and my series is a modification of the late Andrew Ross, merely bringing the series of times into a closer approximation to this law between the two extremes, 3s. and 60m., though in actual practice I find we need not be so particular, so that we are near the proper time. I will now describe how I have practically carried out the elutriation in a way that will be suitable and easy for the amateur to follow. Let him take four vessels which I will call jars No. 1, 2, 3, and waste jar, put the water containing the washed emery into No. 1 jar, stir up and let stand 10sec., then pour half into No 2 jar, fill up No. 1 with clean water, stir up and let stand 10 sec.; pour half into No. 2 jar, stir up No. 1 and pour all into No. 3; this is No. 1 emery. Now with the sponge wipe out No. 1 jar and clean sponge in waste jar, which should be three-quarters full of water, thus clean the sponge and wipe out No. 1 jar several times to make sure that it is free from all No. 1 emery. Now stir up No. 2 jar and let stand 30sec. and pour half into No. 1 jar, now carefully and slowly, so as not to shake up the emery, pour the water out of No. 3 jar into No. 2 jar nearly down to the emery, but not letting any of the emery come over; now pour all the No. 1 emery into a basin to finally settle, putting a bit of paper with 1 on it in the basin to show it is No. 1 emery, clean out No. 3 jar into waste jar, clean the sponge well out and put it on a clean place, and never let it get to the bottom of the waste jar, or it may pick up some course emery and convey it to some of the finer emeries further on. Now fill up No. 2 jar with water and stir, let stand 30sec. and pour half into No. 1 jar. What is left in No. 2 jar is No. 2 emery; stir up and pour all this into No. 3 jar to settle while the next emery is being obtained, clean out No. 2 jar into waste jar. Now stir up No. 1 jar, and here I may observe the hand is best for this with the sleeve turned up, we can then feel that the emery is stirred from the bottom, let stand 2 min., pour half into No. 2 jar. Now, pour off the water in No. 3 jar nearly down to the emery into No. 1 jar, there having been plenty of time for all No. 2 emery to settle during the getting of the first lot of No. 3 emery; and No. 3 jar should always be kept quiet from one emery to another. Fill up No. 1 jar with water, but so as to allow the hand to go in and yet not make it run over; this is always what is meant by filling up. Put the emery in No. 3 jar into a basin for final settling, put a bit of paper in with 2 on it—this is of course No. 2 emery. Now stir up No. 1 jar and let stand 2 min., pour half into No. 2 jar. What is left in No. 1 jar contains No. 3 emery; pour all this into No. 3 jar to settle; clean out No. 1 jar into waste jar, what settles in this waste jar must not be thrown away, it is only waste for the present elutriation; it must be kept for the next. This jar may be the vessel into which the emery is washed from the roughing, and No. 1 emery wets; this will be understood further on. We have now half the emeries, and all the amateur has to do is to repeat the process, only altering the time; the water that is left containing fine emery that will not settle in the one hour had better be allowed to stand 3 hours, and then poured off down to the emery, and this emery kept, so that if the amateur has made any mistake, he will not have lost his fine emery. The emeries in the basins may be allowed to stand for several hours, or till the next day, when the water may be poured off close down to the emery, the emery then can be put into covered vessels ready for use.

The amateur is now ready to begin the grinding of his speculum in the machine—and to prevent scratches, which I have noticed is a general fault in amateur work, I use three jars for washing the emeries off the speculum and tool into after each wet. I keep a separate sponge in each. On the outside of the first jar to be used, I have painted with Brunswick black "R, 1." This means that I wash into this jar with its own sponge, the roughing and No. 1 emery after each wet, so that the coarse emery never gets beyond this jar to the finer emeries; on the second jar to be used there is "2, 3, 4," meaning that I wash these emeries off the speculum and tool after each wet into this jar, with, of course, its own sponge; these emeries may be called the truing emeries for convenience; thus, the particles of the comparatively coarse No. 2 emery never get carried by the sponge into the fine smoothing emeries 5 and 6; on the third jar to be used for the smoothing emeries there is "5, 6," meaning that into this jar is washed these emeries after each wet, by its own sponge—the sponges are kept always in their respective jars, except when in use, when they are kept on the inverted lid of their respective jars. Why the amateur is apt to get scratches is, because he washes his, perhaps, single sponge, into a small vessel that allows the coarse emery to be stirred up each time the sponge is washed, and so some is carried in the sponge to the speculum; and again, using one sponge, some of the coarse emery gets entangled from the beginning in its fibres, and gets set free by the repeated washings of the sponge during the various wets, right down to the finest emery. Now in the trade a very large pan, or even a tub, containing many bucketfuls of water is used to wash the emeries in off the work and tool; this allows the emery to settle below the influence of the surface disturbance caused by the successive washings of the sponge, added to this practice gives a dexterity to avoid sources of error; it is, therefore, better for the amateur to take too many precautions than too few, though it be at the cost of being laughed at by those in the trade.

As I have explained before, it is important to get nearly all the mud from the sludge before beginning the elutriation; otherwise the emeries will not go down well. Now one of the great sources of the finest mud is the two last emeries, for these, after using with a plain tool—*i.e.* an ungrooved tool—become so fine as to be little or nothing but mud. Of course, where grooved tools are used, a lot of emery gets into the grooves and does not get ground down. I should recommend the amateur to use plain tools for though I believe it is impossible to get so near an approach to a spherical surface with plain tools to begin the polishing with, as with properly facetted tools, yet on account of other advantages attendant upon the use of plain tools, and most of all that we must depend finally upon the polishing to get a true figure, I recommend the amateur to save himself the trouble of grooving his tool, and to use plain tools, which if he does, he can afford to throw away his used smoothing emeries, and save a lot of mud getting into the sludge he gets his emeries from. I am indebted for this practical hint of throwing away the two last emeries after use to our obliging and eminently practical friend, "Prismatique," and I have the correctness of the hint confirmed in my notes, for I find I had tried this experiment. I collected the used emery of each number into a separate basin of water during the grinding up of a speculum; I let the emery settle and then examined under the microscope the average size of the emery grains of each number of emery, and I found that each used emery had been reduced two grades: thus, for instance, No. 2 emery, when used, had been reduced to the average size of the grains of No. 4 unused emery: No. 3 emery when used to the size of No. 5 unused, and so on; so it follows that No. 4, the last of the truing emeries, as I call them, and the last I collect when used in my second vessel marked "2, 3, 4," would be reduced to the size of No. 6 unused emery; therefore it is important to keep this emery; but No. 5 emery when used would be reduced to what No. 7 emery would be if we used such a number; but as we do not, we had better throw it away, for it has become practically mud, so No. 6 emery, when used, would become No. 8, which would only act as still finer mud, and impede the going down of other useful emeries; and so it follows these practical hints of our true friend "Prismatique" can be proved to be theoretically correct. There is another hint that he gives that I can bear testimony to: he says, "The great need is to have purity to a great degree, although absolutely *pure* emery is not so good to smooth with as that procured from sludge." Another piece of interesting information I am indebted to our ever-obliging friend for; I obtained it in this way. "Prismatique" very generously sent me a specimen of his elutriated emeries to compare with mine in their use, as I wanted to be able to tell the amateur how to get the very best, taking all things into consideration. Well, I tried them, and found that they cut better and longer than mine of the same fineness. This led me to examine them under the microscope and compare them with mine, when the mystery was all revealed. "Prismatique's" emery for each size was wonderfully regular in the size of its grains, and comparatively very clean from mud, while mine was composed of different sizes of grains to a large extent, for each size of emery, and contained a considerable amount of mud, which under the microscope is very easily distinguished, when the emery is mixed with water and put between two pieces of glass; I used the animalcula cage. Of course I was anxious to know how "Prismatique" got his so regular in size and clean. He very kindly explained that in the trade there is the extra precaution taken of what is called "cleansing" each number of emery, and that it is done in the following way: Each number of emery is mixed with water and well stirred, and allowed to stand till the main body of the emery is down, when the suspended smaller particles and the mud are poured off into the tub or pan in which the sludge is collected. We can easily understand that, when all the sizes are together, that the larger particles will carry down much of the smaller emery and some remaining mud; but when each number is put into its own water alone, it is free from the mass of the smaller sizes and their mud; the second elutriation or "cleansing," as it is called, is carried out under more favourable circumstances than the first elutriation; which accounts for the more favourable result. But "Prismatique" warns that great care must be taken with the fine emeries, and allow time enough for them to go down, or they will be poured away. I think the amateur had better not risk "cleansing" his emeries, and instead, take an extra wet or two of each emery, for I found that it took four or even five wets sometimes, of my emery of a particular size, to do as much as three wets of "Prismatique's."

And now as to the use of the emeries. I do not think I can say much more than "Prismatique" has said in his two letters in our columns I have referred to before. The quantity of emery to be used will perhaps be the most difficult to get at to the beginner; it takes more for the coarser emeries than the finer for each wet; the rule being to use no more than can be kept between the speculum and tool during the grinding, and water enough added to make it into a paste, not thin enough to run down the sides of the speculum during the grinding, and in thus squeezing out, to allow the tool to come in contact with the speculum and drag;—for the finer emeries about the size of half a pea; for the coarser emeries three or four times as much.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

TO "F.R.A.S." AND "PRISMATIQUE."—OPTICAL AND LANTERN TRANSPARENCIES.

[22023.]—I trust "F.R.A.S." will not consider my note on "Shadow v. Mirage" a piece of impertinence; it was written on the day his remark appeared, and why it appears now I cannot say; but I intended the word "screw" to be screen, and also, I fancy I wrote "reflection" in the diagram

I do assure "Prismatique" that I had no intention of making a bullseye in the way he supposes; but my shaft, though barbless, has not altogether gone astray, since it has drawn another letter. Regarding him as I do in the light of an unbreakable bank of practical information, I shall draw on him as long as he will honour the draft, and lest he quote the Hydrostatic Paradox of Controversy and leave me in contempt, let me add that I do not write as one having authority, nor to see myself in print, much less to triumph in argument; but simply to elicit facts.

He says "figuring to surfaces other than spherical has always been resorted to." Now I know that the grinding of lenses to curves other than spherical was attempted before the days of Dollond and Hall; moreover, I never supposed that, except in the earliest days of achromatism, the marrying process was adopted for "best" productions, and not then for larger lenses, seeing that the expense of a large stock of glass would have forbidden it. I supposed one or other curve was reground again and again till it suited, and if, while the ratio of focal lengths was correctly chosen, the radii for curing spherical aberration were wrong, a worker could only produce decent results by curves other than spherical, to obtain which he would find it necessary to have a considerable "take" in one direction or the other on the polisher.

Dollond, we know, did not select the correct curves to cure spherical aberration, so that his final curves must have been other than spherical. Tulley had not a complete theory to work from, and perhaps the same may be said of his work; but what I want to know is, did Dollond *deliberately* choose these spherical radii with the intention of producing curves (ultimately) other than spherical, or did he not rather, when he altered a curve, believe he only had altered its radius or produced a more correct sphere? The "take" might even have been recommended as a means of producing a correct spherical curve. "Prismatique" himself says their practice was to smooth and repolish till a good result was obtained, and suppose the curves then to be spherical, and emphasises this by saying that the old artists did not worry about what the final curves were, so long as a good glass was the result; from which I should have inferred that when on testing they found a curve wanted a "take" at the edge, they supposed the radius wanted shortening. Gundlach, too, assumes the use of spherical curves, or rather mentions no other.

If opticians based their work on the theory, some one of them must have discovered the flaw in the theory. Who was he, then? Or do opticians only use their own curves based on practical experience?

We have the history of the theory and its development pretty complete; when shall we get that of the practice? It seems never to have been written, but has to be gleaned from the traditions of the shop, accessible only to men like "Prismatique," or inferred from the works of old masters. If "Prismatique" and "O. V." would undertake the work, what a book they would make!

Speculum making has fared better than o.g. grinding, chiefly because it has been in the hands of amateurs. From Newton downwards, all the workers of note, save Short alone, have freely given us their discoveries. What a list, putting great and small together: Newton, Hadley, Mudge, Herschel, Rosse, Lassell, Key, Purkiss, Wassell, Blacklock, Tydeman, Bell, "Optical Bricklayer," "Dicturus," and a hundred others. None withholds aught, save With, and he has promised to add his story. We cannot hope to add Mr. Calver's name at present; but it is to be hoped and expected that he will not let his process die with him, as Short and (must I add?) Dollond, Tulley, and the o.g. makers.

Practice and theory are, naturally, jealous of their honours; but I don't think "Prismatique" is fair on Newton, whose *experiments* (*not theory*) misled him; and, after all, if we except Hall, of Essex, of whom we know little (an amateur too), it was not Dollond, but Euler, a pure theorist, who first called in question Newton's results on *theoretical* grounds, and so started Dollond on the right track.

Theory, of course, must have some facts to work with, and an accumulation of facts is of value to test and sometimes suggest a theory; but I fancy theory more often improves the practice than *vice versâ*. However, that is not worth arguing about. The two should be combined, as in the brotherhood of "O. V." with our good friend "Prismatique."

Is there a good process for obtaining lantern transparencies direct? I know the nitric acid one, and it is not successful in my hands. I sometimes draw my picture with white chalk or paint on a black ground (autotype tissue), and photograph that; but though a wrinkle worth knowing, it is not altogether satisfactory, save for maps, when the method, using a blackboard, or slate and chalk, is good. The mountains (usually a difficulty) come out capitally, and are easily stumped by a finger tip. In ordinary cases, a paintbrush and ink, followed immediately by blotting-paper, produce good results.

Bow.

HEATING BOILER FEED WATER.

[22024.]—The interesting description of Engert's steam boiler, in the E. M., points out the value of heating the feed water as a means of preventing incrustation; but according to Calvert and Thwaite, the boiling of the feed water has also a tendency to prevent the internal corrosion of the boiler plates; in fact, the latter authority recommends the addition to boilers of a separate vessel, in which the feed water is to be heated up to 200° Fahrenheit, in order, not only to produce calcareous deposition, but to drive off the air always contained in unboiled water.

J. L. Tomlinson.

PREPARING HARD WOOD FOR TURNING.

[22025.]—I found the following so useful in preparing pieces of very hard wood for turning, that I send it to you in hopes you may find a place for it in your journal. As I had a number of such pieces, from 4in. to 5in. in diameter, which had to be squared at each end, I got some iron rings of ¼in. thickness, which I turned up, inside and out. I bored holes in each of $\frac{7}{16}$in. and put a pinching-screw into each, then put a large face-plate and centre-point on lathe. Having put a squared slot into the face-plate, so that I could move the pin to take in the 4in. ring, I centred the wood and rounded it with the axe at one end, and put in a suitable ring, then put it between the centres. This enabled me to turn up the end square, and by changing ends, the opposite one also, which I could not do by any other means.

Forester.

A "PATENT" FILE.

[22026.]—In reply to "L. B. B." (letter 21995, p. 196), circular files are in use in most engineering shops in one form or another. The simplest and best circular file for general work is an emery wheel; but where the filings themselves are valuable, it is quite common to use a disc of steel cut as an ordinary file. The crankshafts of locomotives are cut out of solid forgings by what are really circular files; the only difference being that the teeth are separate to admit of being taken out and sharpened. If your correspondent will go to any decent toolshop, he, no doubt, will see plenty of circular files if he will ask for circular cutters; these will never replace hand files, as the work has to be held to the cutter, which must, of necessity, be a fixture. No doubt if "L. B. B." wanted to file off the end of a bolt on a locomotive, he would find it "some" easier to do it with a hand file than to hold up the locomotive to a fixed circular file or emery wheel.

Thomas Fletcher.

ELECTRIC ELEMENTS.

[22027.]—"Voltameter" altogether ignores the argument about zero. It, however, points to a mistake in the theory of electricity being two incomprehensibilities; what they are is not stated in the letter 21875. Gordon says that the same law of potentials will not hold for both static and voltaic electricity. Now what authorities has "Voltameter" to support his views? Gordon does not, and Maxwell says that either the two-fluid or one-fluid theory may be used to explain electrical phenomena.

Maxwell certainly concludes that electricity is one of the factors of energy, and that potential is the other, but this is an error which he falls into because he takes no account in the experiments mentioned ("Maxwell's Electricity, 1873," Vol. I. p. 36, &c.) that the electricity is caused by mechanical force in the friction and subsequent separation of two bodies, and afterwards by the force required to place the electrified bodies in various positions with regard to conductors, by which the effects of induction are produced. The force required is very little, and cannot be readily perceived. It is, however, absolutely required to produce the static electrical form of energy, and this force may be observed in much greater strength in the case of inductive electric machines such as the Wimshurst.

It is, therefore, the difference between two potentials—that is one of the factors of energy, and the quantity of electricity movable that is the other.

Maxwell is, however, an authority in my favour, as he compares potential to temperature, and in the case of fluids to pressure; but he fails to perceive that the electricity does not exist in the conductors, and only in the dielectrics they are in contact with, so he is driven to conclude electricity is out of the ordinary law of energy because he treats it as existing in the conductors. More modern authorities have perceived this error, and Planté concludes from his numerous experiments that electricity is propagated by mere mechanical vibration. This is in unison with the known effects of heat, light, and sound. I consider it is sufficiently proved that electricity is a vibration of matter, as no other form of motion could produce mechanical force; but there are many who will not acknowledge it to be correct till further evidence is obtained. In the mean time, the vibratory theory gives a perfect explanation of the voltaic battery, and with regard to Mr. Crookes' experiments, it must be observed that the electric, mechanical, or heat energy is propelled directly from the negative pole, just the same as light and heat in the case of the radiometer.

J. Sutcliffe.

LECLANCHE BATTERY.

[22028.]—Rev. J. J. M. Perry makes mention in letter 21988, p. 192, of a special form of Leclanché battery supplied to him by Mawson and Swan, and he says "of which, I believe, Mr. Payne is the inventor." I desire to correct the error into which Mr. Perry has fallen, as I am *not* the inventor of the battery.

It was originally introduced for telegraphic purposes, and finding that it was well adapted for the particular work of which Mr. Perry speaks, I have recommended it to many persons who, like myself, have used it with pleasure and success. It is a very convenient form of battery for lighting the miniature Swan lamps used by microscopists, astronomers, surgeons, and dentists.

Some persons have attempted to use the ordinary Leclanche attached to their house bells, and failing to obtain the desired result, have said that it was not possible to do that which I asserted: hence my reason for requesting Mr. Perry (when recommending the battery to his friends) to be careful to specify that it was not the ordinary form.

J. B. Payne.

THE VOSS ELECTRICAL MACHINE.

[22029.]—In the interesting description of this machine given by Mr. Frederick Cowle there are one or two points upon which I should much like to be enlightened.

1. How can he, in his fourth paragraph, recommend that the side bearing the thin glass should be kept as near as possible to the revolving disc, whereas it is generally directed that the papered side of the indicator—in this case glazed with thin glass—*should not face* the disc?

What is the supposed action of the thin glass? My small machine of 12½in. diameter has none, and yet works fairly well. Does it increase the length of spark, which, as far as I can see, in the Voss machine never exceeds one-third of that given by a Holtz of the same size? Any contrivance to lengthen the spark would render the Voss machine nearly perfect, constituting, as it does, an almost unfailing source of electricity in any condition of the atmosphere.

2. In making his condenser, how does Mr. Cowle attach the copper-wire loop to the tinfoil coating? His description is not quite clear, and leads to the supposition that he cements the outside plates of the condenser by strips of guttapercha to the central plate in the same manner as is recommended for the thin glass over the inductor. If so, the thickness of the wire loop would, of course, prevent the plates from adhering at one end, and I should think the weight of the whole would very soon draw the wire out from between the plates and lacerate the delicate tinfoil.

Could Mr. Cowle say what ought to be the size of a condenser for my machine? Revolving disc 12½in., inductors on a circular disc.

3. Does Mr. Cowle mount his absorbing combs (Germ. "Einsauger") on the glass pillars where the Leyden jars usually stand, or nearer the revolving disc, and has he a contrivance for making them advance to or recede from the disc at pleasure?

I presume that each comb is separate, and not connected by a bar of ebonite as in my machine, which is one of the cheap simple construction.

The discharging bar, with its combs and brushes is, I suppose, fastened to the axle of the disc; and I should be glad if any one would explain precisely how this part of the apparatus acts. It must be of greater importance than merely to discharge the disc, as it is absolutely essential to the working of the Voss machine, which gives nothing whatever without it, whereas in the Holtz machine it merely increases the effect and lengthens the spark, and, indeed, its introduction was comparatively recent. The whole action of the Voss machine is to me very far from clearly intelligible, and altogether different from that of the electrophorus; whilst the constant change of polarity which occurs in mine at almost every discharge, is to my mind most difficult to account for, notwithstanding Mr. Sprague's elaborate attempt at explaining it in a former number of the "E. M."

If we clearly understood it, we should be able to prevent it altogether; and this would enable us at once to accumulate a far higher degree of tension on the poles, and consequently lengthen the spark.

My machine with 12½in. disc will never, under the most favourable circumstances, give more than two inches with Leyden jars attached, while on substituting the Holtz discs I at once obtain a good clear six inches.

Would it not be possible to design a double machine—a small Voss to supply a constant charge to the inductor of a large Holtz machine, which itself would produce very powerful effects – the two discs to be revolved by the same handle. We might then have a Voss machine with a disc of six inches supplying electricity to a Holtz with one of 36, by which means we should always be able to obtain a spark of 16 or 18 inches in length, as the normal length of the Holtz spark may, I believe, be reckoned at nearly half the diameter of the disc.

Were this possible, we might have, at a comparatively low cost, a machine capable of producing the most formidable effects.

Ethel Constance May.

HOW TO MOUNT FOR THE MICROSCOPE. II.—PRELIMINARY EXAMINATION OF OBJECTS.

[22030.]—I NOW proceed to give some hints on the selection of objects and the preliminary examination of them.

Classification of Objects.—As to what to mount: almost anything may be mounted, so long as you get it not with man's handiwork on it, but bearing only that of nature—clean, small, and either almost transparent, or with a natural surface capable of being viewed by reflected light. The objects for mounting may, accordingly, be either inorganic (elementary bodies, salts and other chemical compounds, ores, rocks, etc.) or organic; and the inorganic specimens may, if thought appropriate, be distinguished by a brownish, vegetable by a green, and animal by a pink label. The inorganic will be intended either as examples of crystallisation, or to subserve other purposes; and the organic will be intended as specimens of tissues, of organs, or illustrative parts of organs, or of entire animals or plants, or characteristic parts of them. This may serve as a rough classification of objects, which will help to mark off the ground we have to travel.

Necessity of Preliminary Examination: Crystals.—Among the most beautiful purely inorganic objects are crystals, which, when fairly transparent, may be tried with the polariscope; but before attempting to mount either crystals or anything else, it is necessary to make oneself familiar with their behaviour when unmounted. The crystalline form is assumed by an immense multitude of bodies (which are for that reason called crystalloids) when they are deposited from solution, or from the liquid or gaseous state. The usual way of causing them to crystallise is to dry a solution—generally a watery solution—containing them. Let the reader, then, before attempting to mount any crystals, dissolve small quantities of various crystalloids in water, place a drop or two of the solutions on slides, allow them to dry, either with or without the aid of heat, and examine them without and with the polariscope, both when dry and when in the act of crystallising and drying. In this way he will see twenty specimens where, if he confined himself to mounting, he would see only one; and any chemist whom he knows will give him for a penny or two a few grains each of a number of soluble salts, especially if the chemist knows he is working at the microscope and is likely to be a customer. Chloride of sodium (common salt), alum (potassio-aluminium sulphate), ferrocyanide of potassium, nitre (potassium nitrate), lump sugar, Epsom salts (magnesium sulphate), and the three kinds of so called vitriol—white vitriol or sulphate of zinc, green vitriol or sulphate of iron, *and blue vitriol* or sulphate of copper, afford easily *obtainable and not very difficult examples. They at the same time illustrate the six systems or fundamental types of crystallisation.*

The Monometric System—Salt and Alum.—Alum and common salt exemplify the first, the cubical, regular, isometric, tessular, or monometric system, of which the original form is the cube, whence octahedra arise. To understand this, take a square of soft soap, or cut a small square out of a larger one. If exactly cut, it will be a cube; that is, its six sides will be equal squares, at right angles to each other, and it will correspond in shape to a cubical crystal. Now make a dot exactly in the centre of each of the six sides, and thrust, or imagine that there is a thrust, a needle from each dot through the centre of the piece of soap to the dot opposite it. The parts of the three needles which do not project beyond the surface of the soap will then answer to what are called the three axes of the crystal—three lines drawn through its centre in the direction of its length, breadth, and thickness or depth. These three needles, lines, or axes, will in the above example be (1) at right angles to each other, and, (2) of equal length; which are the characteristics of the monometric system. The edges or corners may now be flat bevelled, giving a variety of secondary forms: and, in particular, if each of the eight corners is bevelled at a right angle to a line drawn to it from the centre, till the new corners meet at the ends of the axes, a regular octahedron, a figure with eight equal triangular sides, will be produced. Common salt crystallises in cubes and alum in octadedra, in which salt may also be made to crystallise by being previously dissolved in a solution of fresh urine. It is not, however, to be supposed that monometric crystals are always simple cubes, or octahedra. The two forms may be combined; edges or solid angles may be shaved off, giving additional faces. Some faces may be larger than others, because they have been more freely exposed to the solution, or two or more crystals may grow together or interlock (twin crystals). The upper half of an octahedron, for example, may grow on the top of a cube, or you may get a half-cube or octahedron. Analogous phenomena present themselves in the other systems, so that I must content myself with describing the forms from which the others are produced by shaving or flat bevelling, or, in other words, by arrest of growth at certain parts of the crystal.

The Dimetric System—Yellow Prussiate of Potash.—The dimetric, quadratic, square prismatic, or pyramidal system—in which the axes are still at right angles, but one of them, *longer* or *shorter* than the other two—is exemplified by potassium ferrocyanide or yellow prussiate of potash, a commercially important salt, which the reader will find indispensable if ever he injects the vessels of animals with prussian blue. To understand this system, take a new, unsharpened, and circular lead pencil. It is a cylinder. Cut the sides till flat surfaces are produced, and you have what is commonly called a prism—a hexagonal prism if six sides are left, a triangular one if there are three, and so on. The primary form of the square prismatic system is a square or quadrate prism, which is, in effect, a cube prolonged into a square column—i.e., into a column of which the cross section is a square. Again, the ends of the pencil, or of part of it cut off, may be sharpened, not round, but so as to leave each end with four equal triangular sides, like half of such an octahedron as was described above, and differing from it only in being, as it were, pulled out or pressed in. Or the two forms may be combined, a piece of the prism being left in the middle; or the two ends may be cut off at right angles to the length of the pencil, which may, finally, be bevelled in various ways.

The Hexagonal System: Potassic Nitrate.—This system differs from the dimetric only in that the pencil must have six equal sides instead of four; or, in other words, there are three equal secondary axes in the same plane, and having an angle of 60° to each other, and a primary axis at right angles to that plane, and longer or shorter than the secondary axes. Such crystals, when in their simplest form, look like hexagons as seen from above, and like couples of triangles placed base to base when lying on their sides. Snow-crystals are of this shape; and potassium sulphate, which, however, really belongs to the trimetric system, often crystallises in a form quite indistinguishable from the hexagonal; as also nitre usually does. Such a figure as that described has 12 equal sides (if a prism is not inserted between its two ends). If, then, six of these sides grow, and the other six abort, a rhombohedron, a figure bounded by six rhombi, may result. From the frequent occurrence of such figures (soda nitre, or nitrate of sodium, belongs to the hexagonal system, and crystallises in rhombohedra, which closely approach to cubes); the hexagonal is also called the rhombohedral system. A rhombus is a straight-sided, four-sided figure, in which the sides are of equal length; but the angles are not right angles. Other more complex figures may also result from bevelling. Thus, if the hexagon has its sides doubled by bevelling, what is called a "scalenohedron" may appear.

The Trimetric System: Sulphate of Zinc.—Where, as in salt and alum, the three axes are equal, it is sufficient to measure one; hence it is that the first system is called monometric. The second and third are both dimetric; that is, two must be measured. But in the complicated forms of the third system it is difficult to recognise the axes. In this fourth plan of crystallisation, as in the others, the axes are aclinic (α not, κλινη a bend), that is, do not slant or bend towards each other—i.e., and do not leave a greater angle one way than another. But they are all of different lengths, so that to measure the crystal, the three must be measured. For this reason it is called the trimetric system, and it has also received the names of rhombic, prismatic, right prismatic, orthotypic, and isoclinic. These names I give simply because a reader might find one of them used in one book and another in another, and might not know them to be equivalent. The simplest form of a trimetric crystal is a couple of right four-sided pyramids joined by their bases, and having their opposite, but not their adjoining, sides equal. A right pyramid, prism, cone, cylinder, &c., is one planted perpendicularly on its base like a new pencil, and not sloping to one side like the top of a hop kiln. A four-sided prism may be interposed between the pyramids. Sulphate of zinc crystallises in this way in the cold, and so does sulphate of magnesia crystallising from a cool solution. This is also, as has been said, the veritable crystalline shape of nitre and sulphate of potassium, the hexagonal form noticed above being produced by bevelling, which may be seen in different stages on different crystals. In consequence of bevelling, rhombic and rhomboidal faces, faces with only two opposite sides equal, or quite irregular, are frequently met with.

The Monoclinic System—Sugar.—These crystals, of which sugar affords an example, are usually easily recognised by being sloped, and sloped in one direction only; for while, as in those which are denominated trimetric *par excellence*, the three axes are unequal, one of them is at right angles to the other two, but these are not at right angles to each other. The sulphates of iron, sodium, magnesium, when first boiled down and then left to finish crystallising at rather more than blood heat, and zinc crystallised at about the same temperature, afford other examples of monoclinic crystals, of which the last two are especially interesting, because the sulphates of magnesium and zinc also crystallise, as we have seen, according to the trimetric method. The reason of the difference is that when crystallised cold they contain seven, and when crystallised warm retain only six molecules of water.

The Triclinic System.—Sulphate of Copper.—In this system, all the *three* axes *incline* or bend, none of them being at right angles, or, in equivalent words, perpendicular to any of the others. Sulphate of copper, which is also interesting because it is dichroic, affords an excellent example. A dichroic crystal is one which shows of one colour when the light is transmitted through it in one direction, and of another when it is transmitted in another. Such crystals as chloride of potassium, which is monometric, may seem to polarise without a polariscope, and when they polarise the dichroism adds to the richness of the effect.

I do not give the above as a full or complete account of crystallisation. I have endeavoured merely to explain the general features of the six crystalline systems without technicality, and to illustrate each by an example of a common substance soluble in water, incapable of doing mischief unless the reader eats it, and easily examined microscopically. The examples are set at the heads of the paragraphs. I have just been going through them again to make sure of them. For the material of the theoretical part of the paragraphs I have used the article crystallography in "Watts' Dictionary of Chemistry."

Many crystalloids, like sulphate of zinc or of magnesia, crystallise in two (or more) different ways. They are then said to be dimorphic or polymorphic. But, independently of this, no user of a microscope must omit to notice—

Different crystalline forms assumed by the same body.—Any crystalloid, polymorphic or not, can be made to assume the following forms, which are modifications of the first, to which the preceding sixfold division refers.

First, the shape or shapes given in books of chemistry and classified above. To see this, take a little of the substance, and add water to it till the whole is dissolved, obtaining as strong a solution as possible. Place a drop or two of this in the centre of a slip of glass, or, still better, of a shallow gold-size, or a deeper, cell. As the drop begins to dry, crystals will form perhaps round the edge. They may be taken away, or placed near the middle, with a fine glass rod, and in the same way two crystals which by growing are going to touch may be separated. Crystals form best from a somewhat turbid solution, since the particles which cause the turbidity give the crystals something to start from. Notice the beginning of the crystallisation—for the crystals may be seen forming if the stage is not tilted so as to cause the liquid to run. At first will be perceived a minute mass with no definite crystalline form. Watch it with the highest power you can use; and the crystallising liquid will be seen filled with much smaller specks, which dissolve in the neighbourhood of the mass, evidently passing to it in a dissolved state through the liquid, for the mass concomitantly increases in volume. The crystals will be irregularly developed if all their sides are not equally free to receive these additions; do not, therefore, allow the liquid to become very shallow in order to obtain larger crystals, since, for ordinary microscopical purposes, it is of no use to have a crystal so large that the whole of it cannot be brought into focus at once. Dry up the liquid with blotting paper when the tops of the crystals get near the surface—white thick blotting paper is the best, and a torn edge absorbs better than a cut one, and try tilting the slide or cell in different directions, so as to make the liquid run this way and that, and roll the crystals so as to prevent the face next the glass from being stunted. For sugar, use a thick drop of syrup on a bare slide; for alum, allow a few drops of a hot saturated solution to begin evaporating on the hot hob in a deep cell.

Secondly, if a more dilute solution—say five per cent.—be used, or a thinner drop be laid on the slide and allowed to dry without any of it being removed by blotting paper or otherwise, modified and flattened forms, joined together, will appear. These may be obviously what they always are in reality, flattened and joined modifications of the original crystalline shape, as with a not very thin drop of solution of acetate or sulphate of copper, as with sulphate of zinc and magnesia, they may be traceries like those seen on the windows in frosty weather. But the original shape always reveals itself; the traceries of monometric, and consequently rectangular salt or alum, are rectangular, and those of clinic, or non-rectangular sulphate of copper, are oblique. Or they may be butterfly-like, as in sugar, since the crystals spread out in the direction in which there is the most plentiful supply of material. On account of alternations in the richness or poorness of the fluid (the surface of which may often be observed to form ridges before crystallisation commences), or because of aggregation of the crystalline particles in layers or in minute oval, leaf-like, or other masses, markings will often be seen in the crystal as it advances.

Thirdly, if a still thinner layer is secured—e.g., by tilting the slide on one side so as to make the drop run, and especially if the drying of the solution is accelerated by warming the slide over a spirit lamp, the above phenomena will be mingled with or replaced by others still more beautiful. If the crystalloid is one which to crystallise will absorb water from the air—a trial will determine whether this is the case or not—the slip may be allowed entirely to dry over the lamp; a mere film of moisture may otherwise be left, or the slide may be breathed on after being dried. At first nothing particular will be seen; but, presently, scales, shells, or shafts of crystallisation will appear, starting from centres (which may be made artificially in some cases by touching the slide for an instant with a fine capillary tube containing water, and in others by touching it with a heated needle), and radiating till they meet others from other centres, so as sometimes to form roughly hexagonal or six-sided figures. Viewed with a high power (through a covering glass), this arrangement seems to me to consist of innumerable little crystals pointing to the centre, and placed end to end like little magnets. Try sulphate of copper, tartaric acid, citric acid, and sugar (separately). Irregularities in cooling or drying may produce twisted, curved, or wave-like or fluted forms, especially if they dry warm. The addition of a *little* gum to the solution improves them in many cases; if somewhat more is added, they tend to become hairy or woolly. At first they may be quite smooth and fine from edge to edge; but secondary aggregations are apt to form within them, producing a broken appearance, with, it may be, a look of curling, like that of leaves as they wither. Sometimes circles form, with concentric markings, either in or external to the scales spoken of above. If breathed on, only the general figure of the original circle is left; but new markings appear round its circumference, the whole having the appearance of one of those crystals of carbonate of lime in gum or silica of which so much has been written, and being due to the same cause —crystallisation under difficulties.

Fourthly, new forms (which, as in the other cases, are, I suppose, only modifications of the primary one) present themselves on dissolving the crystalloid in gum of the consistence, say, of olive oil.

And fifthly, if the slide is overheated or allowed to dry too rapidly, there is no time for regular crystallisation to take place. Shapeless, or almost shapeless, crystalline masses are formed; the water of crystallisation is driven off, and a powder is left, or the crystalloid itself is decomposed.

Francis Grant.

AN INEXPENSIVE BELL BATTERY

[22031.]—Prescott describes a [illegible] battery where bichromate of pot[illegible] acid take the place of nitric [illegible] battery. The solution is mad[illegible] bichromate of potash in 5lb. of hot water, and when cold, adding strong sulphuric acid. The zinc is placed in the outer jar containing a saturated solution of common salt, which is made by adding salt until the water can dissolve no more. Five of these cells give a fair current to a small lamp, but the porous pots are soon ruined—sometimes the bottom coming completely off.

But to make a cheap battery of this description for bells, the elements must be reversed. In the outer jar should be a large surface of carbon in bichromate solution (adding a few drops of sulphuric acid), the lumps of graphite packed closely round the porous pot. Inside the porous pot a strip of zinc is placed in a solution of salt. Two of these cells coupled for intensity will be sufficient to ring any ordinary bell. If you do not wish to spoil the porous pots, place just enough salt to acidulate the water—say half a teaspoonful to each. The bichromate will last a long while; but the saline solution in the porous pot should be changed once in 6 weeks or two months. To keep a couple of porous pots in clean water in reserve would be as well, as all the impurities would soak out in the mean time. A couple of these cells can easily be made up by experimental electricians for next to nothing in cost, as many have most of the materials required at hand.

Reading, Oct. 30. **S. E. Kelf.**

CONCERNING LOCOMOTIVE ENGINES.

[22032.]—According to Mr. A. Luis, page 295, the resistance per ton of a train is given by the formula

$$R = 12 + \frac{v^2}{114}$$

where v is the velocity of the train in miles per hour. Taking this as correct, the total resistance of a train weighing W tons (which I suppose includes the weight of the engine) will be

$$\frac{1368W + Wv^2}{114} \text{ lb.}$$

The train moves over $88v$ feet per minute, so the amount of work done in that time is

$$\frac{120284Wv + 88Wv^3}{114}$$

and the horse power $= \dfrac{(120284 + 88v^2)\,Wv}{3762000}$.

I would like some particulars as to number of strokes per minute made by different classes of locomotives. I note the expression given by Mr. Stretton on page 182, for the tractive force of engines, and am rather surprised that the factor $\frac{\pi}{4}$ is not involved, as regards the area of piston. There is nothing in the formula to indicate the rate at which the engine can move while exerting the said tractive force. How is this rate calculated?

Quayside, Newcastle. **W. John Grey.**

DOUBLETS FOR MICROSCOPE.

[22033.]—It has long been well known that by using two convex lenses in the place of a single one we may obtain a less amount of spherical aberration than by using a lens of the same power as the pair. It has even been said that we may reduce the aberration to 0. Thus Dr. Parkinson ("Optics," p. 124, Vol. III., Ed. 3) gives two examples in which this is said to take place; but as he gives us no demonstration, or even any explanation of how such a thing can happen, we are left to receive it on faith; and perhaps after all it is not very much to ask us to believe it on the word of so great an authority as Sir J. Herschel, from whom the examples are taken. I regret to find, however, that the formula which has been used to obtain the conclusions given below, gives results which are utterly at variance with the idea that the lenses are aplanatic, and therefore I would not have ventured to write upon the subject had it not been that the formula above spoken of will bear the strictest testing by a method which appears to be quite unexceptionable. One of the simplest forms, then, that can be proposed is when the doublet consists of two equal plano-convex lenses, having the curved side of one of them touching the flat side of the other, and the flat side of the pair turned towards the eye. The spherical aberration of a ray falling upon the pair will thus be reduced to five-fourteenths of that of the same ray falling upon the equivalent single lens of the same form.

We may [illegible] still further reduction by substi[illegible] and a meniscus whose [illegible] aber[illegible] contact [illegible] first with one side and then with the other, towards the object, and I have often fancied that there is not only a difference in distinctness, but also a sensible, though small, difference in the amount of colouring, owing to the fact that the spherical aberration is greater for blue than for red rays, causing what Mr. Bradbury happily names "spherico-chromatism."

If, now, for one of the convex lenses we substitute a concave one, we may reduce the spherical aberration to any extent we please. Thus, suppose one lens is a double convex, with radii in proportion of 5 : 6, the more curved surface being outward and toward the object, and the other a plano-concave, with flat side outward, and having a focal length twice that of the other; the spherical aberration will be reduced to less than a hundredth part of the first lens, and if, besides this, we make the concave of flint glass, we should get a pair which should be passably free from aberration of both kinds, though in the latter case the spherical aberration will not be so well corrected as with common glass. **W. G. P.**

LEGAL REPLIES.

[22034.]—Telegraph Wires (52146).—The querist has confused the Statute of Limitations, which now gives 12 years instead of 20 as to real property, with the Prescription Act that deals with the acquisition of easements. I do not think any user—at all events, under 20 years—can give the Post-Office authorities such an easement over the land of the querist as would prevent him at least raising the wires. I should advise him to object to the wires at once, and require an acknowledgement from the authorities that they are on his land by his leave, in which case the 20 years' user would not give any right.

Poor-Law—Wife's Maintenance (52150).—I think the order made by the magistrate would remain valid until rescinded. But if it became necessary to enforce it by distress, the magistrate might require it to be shown that the wife was still in need of support to the same extent as when the order was first made.

Sale of Spirits—Fraud (52162).—This raises several rather curious questions. It is, I think, quite clear that if a wife obtains wine or spirits under guise of grocery, and without her husband's knowledge or authority, he cannot be made liable for their price. In the same way, I think what he has been deluded into paying by this sham he could recover back again from the grocer as money obtained by fraud. But it is not so easy to see how the case could be made a criminal one. There is no such vague crime as "fraud." A false pretence must include a false pretence of an existing fact, made with the intention of defrauding, and which does defraud, the person in question. The fraud is certainly gross, and in every way to be condemned; but I do not think that it would support a criminal conviction. **Fred. Wetherfield.**

2, Gresham-buildings, Guildhall, E.C.

Errata.—The Eye of the Flea, p. 196.—The engraver has reversed the drawing and not the letters. Transpose A and B and shift *d* and *c* to the proper focal points.—T. P.

Errata.—Study of Pyrology.—Several errors have, unfortunately, slipped into Col. Ross's letter on p. 193. In middle col., 14th line from bottom, read "primordial progression"; in 3rd col., 27th line, read "unproved"; p. 194, 25th line, read "separates in large"; 35th line, read "rationalistic tree"; 42nd line, read "rising"; 46th line, omit "how."

Incandescent Lamps.—Would it be surprising to many readers to learn that incandescent electric lamps were used forty years ago to illuminate a mine? We are so accustomed to be led away by the rapid progress of the last few years as to forget the work of pioneers. Carbon in a vacuum was used in the lamps above referred to; but of course the vacuum was not so high as that at present used, because the apparatus for obtaining it was not so perfect.—*Electrician.*

South American Timber.—Some investigations by M. Thanneur show that South America is rich in woods for engineering purposes. The yandubay is exceedingly hard and durable; the couroupay is also very hard and rich in tannin. The quebracho is, however, more interesting than any, and grows abundantly in the forests of La Plata and Brazil. It resembles oak in the trunk, and is used for railway sleepers, telegraph poles, piles, and so on. It is heavier than water, its specific [illegible] varying between 1·203 and 1·333. The [illegible] first is reddish like mahogany; but grows [illegible] time. Being rich in tannin, it is em[illegible] leather in Brazil, and has [illegible] for that purpose into [illegible] one-third of powdered [illegible] of ordinary tan gives

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51064.]—**Soldering.**—I am sorry if I mistook what B. T. Lewis said; but he must not suppose that though on occasion I have used oil or grease, that I approve of them, or would at all recommend the use of them. As "A., Liverpool," refers to tin, I must say a few words on one or two things in his letter. I particularly referred to soft-soldering brass, silver, and tin. Now, in soldering these, a flux is not used—only something which will evaporate at about the same temperature as the solder melts, and so keep the metals from oxidising. Some people use one thing, some another; but I have never found anything so good as muriate of ammonia, as it used to be called, or the old name, sal-ammoniac. I don't think it does quite so well for iron unless, while the soft solder melts, it is rubbed about with a bit of charcoal. It wants no cleaning off, like rosin. For hard-soldering a flux is required to make the spelter melt more easily, and so borax is used, which not only does this, but spreads a covering from the air over the metal to be brazed. "A." is quite right when he says all grease should be avoided.—Edwd. Thos. Scott.

[51607.]—**Dissolving Human Hair (U.Q.)**—I don't think this querist will ever obtain what he desires. Even supposing that the potassic hydrate could be entirely removed without leaving anything in its place, which would practically be extremely difficult, not to say impossible (evaporation being out of the question), the hair ought to be precipitated in the form of powder (!)—R. A. R. Bennett.

[51619.]—**Specific Gravity.**—I am very grateful to Mr. Alfred H. Allen and to "N. C. R." for their kind replies; but if Mr. Allen will allow me to trouble him once more, I should like to ask the reason for employing the constant 38·5, and the method by which it is obtained, as this knowledge may perhaps enable me to discover that which I am in search of—viz., a rule for the determination of the quantity of any simple substance from the sp. gr. of its solution by means of different equations. —J. R.

[51698.]—**Yeast.**—I see various replies have been given to "E. R. D." and others about yeast; I venture to add one to the number. Some years ago we made bread at home, and were often troubled to get yeast—of course, brewer's yeast—which often made the bread bitter. I got a recipe for artificial yeast, which we found to do well; but it must be kept in a jar, not a bottle. Hops, ¼oz., boil for 20 minutes and strain; rub fine 1lb. of potatoes, mix with the liquor, and set to boil; mix with it a ¾lb. of flour made into a paste with cold water, cool, and add ½ pint of yeast mixed with 2oz. dried flour. In using let the water be warmer than usual. One pint is sufficient for 12 or 14lb. of flour. We also used the old leaven, which does very well, and gives no bitter taste. I am surprised it is not used more.—Edwd. Thos. Scott.

[51768.]—**Joy's Valve Gear.**—If "Historian, J.A.H." will forward me particulars of size of his engine, and a skeleton tracing of it, I will inform him the royalty on it according to size, and will furnish him with 3in. scale drawing of valve gear, which is included in the royalty.—David Joy, 8, Victoria Chambers, Westminster, London.

[51792.]—**Cancer in the Mouth.**—"St. Bart.'s" mentions in his communication that he has seen 300 cases of cancer in the lower lip. May I inquire did every one of these smoke, or had they been smokers up to the time of the appearance of the cancer? Also, did any of the men smoke cigars only, or pipes only? If pipes only, were they meerschaum or amber tipped, or was the common clay used? I ask this to gain information whether or not it was caused by the adhesiveness of the clay pipe, or whether it is due to the irritation of any pipe.—T. R. Allinson, L.R C.P., &c.

[51807.]—**Tinning Bright Iron.**—"Gotha" should find an answer to his query on p. 346, last volume. Gore, "The Art of Electro-Metallurgy," gives several processes, or rather solutions, some of which are worked in Birmingham, but I believe the best is that now used by the company established by Mr. Elmore.—Nun. Dor.

[51814.]—**Mahogany Stain.**—"D. W. W." should say what wood his furniture is made of, and the kind of stain used. Is he prepared to rub off the polish and restain? If so, he will find recipes in back volumes.—Nun. Dor.

[51821.]—**Window Fernery.**—If you want your plants green in winter, you will require to heat your fernery—anything that you can keep up, but not less than 45°. There is nothing better for a case in a room than the filmy ferns, of which there are many beautiful kinds, and which love the atmospheric conditions they there find. Prominent amongst these is the Killarney fern, the most easily managed as well as one of the most beautiful. Then there are Club Mosses (Selaginellas), which are most suitable, notably, S. opoda, Mertensi, denticulata, hortensis, and cæsia; these are just at home in a case, and present a very fresh and attractive appearance. The soil should consist of good peat in lumps about the size of a walnut, ejecting all dusty particles, and mixing with it plenty of silver sand and some small pieces of charcoal. In this the plants are to be planted, and they will need but little water if the case is to remain closed, merely opening it for an hour or so in the morning.—G. J.

[51831.] — **Electric Gas Lighter.** — The "battery" is, no doubt, a chloride of silver cell, and information will be found about the identical (I suspect, for querist does not explain) thing on p. 391, No. 927. Directions for making chloride of silver batteries on p. 73, No. 913.—Nun. Dor.

[51832.]—**Damp Shop.**—Ventilation is the best thing; but something depends on the cause of the smell. If it proceeds from dry-rot, it is doubtful whether much can be done without pulling up the floor and putting in new joists, &c., taking care then to secure free ventilation underneath, and, if possible, a concrete or asphalte coat over the ground. —Nun. Dor.

[51834.]—**Soap and Soda.**—I would suggest the use of the microscope.—C. T.

[51850.]—**Canoe or Small Sail Boat.**—The plan of emptying a boat of water by it own motion involves the use of a valve, which is so arranged that it will let water out of the boat but not allow any to enter. As the boat is forced through the water the valve opens and the water in the boat escapes. Some life-boats are fitted with these self-emptying valves. A mere pipe with a tap or plug cannot be relied upon.—Nun. Dor.

[51899.]—**Medical Coil.**—When I placed the coil in the tube I could feel no difference. Taking the E.M.F. of a bichromate of potash cell as 100, the E.M.F. of a chloride of silver cell is about 60. In the chloride of silver cell there is a silver plate which has chloride of silver melted on each side. A zinc plate is clamped on each side; between each plate there is a pad of blotting-paper, which is saturated with chloride of zinc. Gaiffe's cell is made like this.—Watt.

[51899.]—**Medical Coil.**—The latter part of this paragraph (page 201) has been misprinted (or miswritten). It should read:—"With no free liquid, but sodden blotting-paper—i.e., blotting-paper saturated with the solution used. Is this of sufficient power for the purpose?" I have read (in the English Mechanic, I believe) that a condenser makes very little difference in the shocking power of a coil, but a great difference in the length of spark obtainable. Will somebody please explain this? It passeth my understanding.—Thor.

[51905.]—**Tool Cabinet.**—I have laid down a simple plan for keeping tools together. Fig. 1 can be extended to any extent. It is composed of a length of deal, nailed on to a wider piece, with partitions between. This is for holding chisels, gouges, bradawls, screwdrivers, gimlets. I have mine nailed to a dry wall, within easy distance of bench, in workshop. Fig. 2 will hold the planes and other things. In putting away the bits, fit a piece of wood into the space allotted for them; bore holes through, and square up the holes with a chisel. Then put the shanks of bits in the holes; this leaves them sticking up without touching. This piece can be taken out when wanted; select the bit, then put back in place. Always make a practice of keeping a tool in one place, so that when wanted you will know where to find it.—A. Best.

Fig. 1.

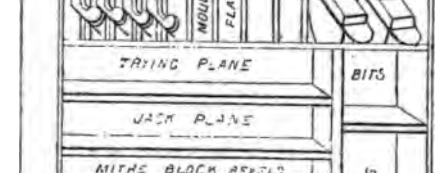
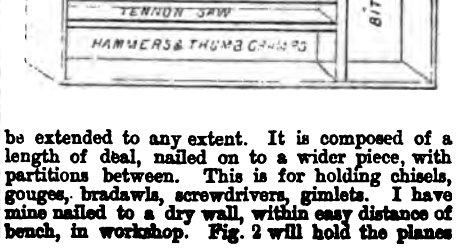


Fig. 2.

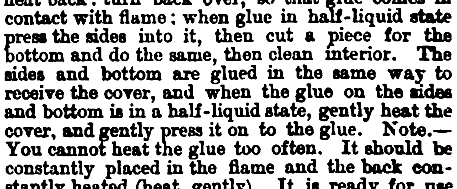


[51935.]—**Law of Copyright.**—The proprietors of the magazine, having paid A. for the article, it becomes their property; and if they choose and see fit to enter it at Stationers' Hall as copyright, *they* would have the right of action as against the other proprietors for infringement of copyright.—J. Russell Pridham.

[51944.]—**Coppered Wire.**—I think "Ressorp, F.C.S." and "A Practical Chemist" are rather hard upon S. Austel, as they took no notice of the answer of "Chemicus," who made exactly the same mistake on p. 320 last volume. It is a great pity that these misleading names are given to so many substances. There is no reason why sulphate of copper should not be called "bluestone"; but why call sulphate of iron "copperas" for no reason whatever? I think myself that there is copper sulphate *and* copper sulphate. If it is not pure it does not produce nearly such good results. The more acid the solution is made, and the longer the articles are immersed, the more the copper adheres to them. I don't quite see how anything covered with copper itself in the metallic state can look otherwise than "coppery." The copper could be deposited on the wire by electricity, but it would be a vast deal more trouble. The wire must be perfectly clean and bright.—R. A. R. Bennett.

[51944.]—**Coppered Wire.**—"Practical Chemist's" reply to this query on p. 201, leaves something unsaid: it omits the process recommended by your correspondent. It is easy for any-one to criticise: what is wanted is information. As a matter of fact Mr. Bennett's reply is perfectly correct, and is quite efficient for giving a slight film of copper to iron articles. Gore gives several recipes, the simplest of which is Roseleur's, for iron wire, equal parts sulphate of copper and sulphuric acid to 100 parts of water. If the wire is properly cleaned and after immersion is run through a draw-plate, the film of copper will be very adherent. Dr. Puscher's method is 10 parts sulphate of copper, 5 sal-ammoniac, and 150 water. The articles are to be subsequently heated over a charcoal fire, to drive off and waste the ammoniacal salt. Another preparation is hydrochloric acid 1, water 3; a few drops only of a solution of sulphate of copper are to be added from time to time. Where a stout coat of copper is required, such as for cylinders of calico-printing machines, the battery must be used.—Nun. Dor.

[51949.]—**Zoophyte Troughs.** — **Materials.**—Back, plate glass 3in. by 2in.; sides and bottom, slips of glass ¼in. wide, ⅛ or 1/16 (or ¼ if liked) thick; covers, thin glass 2in. by 1¼in.; marine glue (soluble), obtained from any tool-maker, about 1s. per lb.; spirit lamp (mounting table recommended), dissecting needles. Directions.—Place the cover on the back in the middle touching the bottom, mark round its sides and bottom thus: take the cover off, heat the back. Take a small piece of glue (size of pea or smaller) on end of needle, heat in flame until it lights, then place on glass on line, so on until line is covered with glue ¼in. thick; heat back over flame, and with finger damp (not wet) press the glue until it sticks on the back well. Take two strips of glass, length of sides of cover, again heat back; turn back over, so that glue comes in contact with flame; when glue in half-liquid state press the sides into it, then cut a piece for the bottom and do the same, then clean interior. The sides and bottom are glued in the same way to receive the cover, and when the glue on the sides and bottom is in a half-liquid state, gently heat the cover, and gently press it on to the glue. Note.—You cannot heat the glue too often. It should be constantly placed in the flame and the back constantly heated (heat gently). It is ready for use immediately. I first wrote out the above three years ago, and can add nothing to it, save that I have always found the troughs give entire satisfaction.—John Alex. Ollard, F.R.M.S., Enfield.



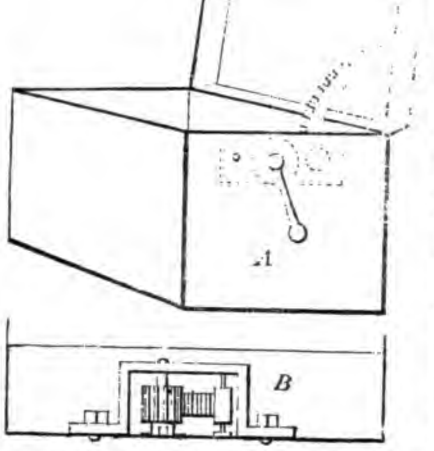
[51961.]—**Cleaning Object-Glasses.**—I am very much obliged to "F. R. A. S." for noticing my query to Mr. Lancaster and "Prismatique."

There is another point in connection with objectives that I should like to submit to him. Some three years ago, upon the recommendation of Mr. Lancaster through these columns, I had the lenses of a small o.g. cemented together with Canada balsam. The improvement was unmistakable, both as regards light and definition. Now, I am aware that that process is not applicable to anything above 3in. in diameter on account of the unequal expansion and contraction of the two glasses, which if cemented together would subject them to a severe strain. But why not employ some permanently fluid body, such as castor oil, to connect the two lenses? A simple experiment with two pieces of plate-glass will convince anyone of the advantages of optically connecting the two surfaces by a drop of castor-oil spread between the two plates. They then look like one solid glass, and when put upon a sheet of white paper their transparency is very marked. Now, before making a similar experiment with my 3¼ o.g. I should like to know whether anything of the sort has been tried, and if not, whether the experiment is likely to injure the glass. The success already alluded to, on a small scale, leads me to hope for an improvement in light, if not in definition.—ACHROMATIC.

[51991.]—**Star Magnitudes.**—The magnitudes in Proctor's atlases are taken from the British Association Catalogue in the majority of instances; but in respect to a number of the brighter stars they are taken from Sir John Herschel's "Photometric" table. Upon the latter scale all the magnitudes are lowered by about half a magnitude. The following are the estimates of various authorities for these stars. Sir John Herschel's measures are from the "vulgar" column of the table referred to. α Andromedæ: Sir J. H. 2·54; Heis, 2·0; Baxendell, 2·36; Piazzi, 1; Argelander, 2·0; Flammarion, 2·0; Sir W. Herschel, 2·1. α Coronæ: Sir J. H., 2·69; Heis, 2·0; Bax., 2·65; Arg., 2·0; this star is possibly slightly variable. α Ophiuchi: Sir J. H., 2·63; Heis, 2·0; Sir W. H., 2·0; Arg., 2·0; Flam., 2·0. α Capricorni: Heis, α^1 4·0, α^2 3·0. γ Ursæ Majoris: Sir J. H., 2·71; Heis, 2·3; Arg., 2·3; Pickering (mean), 2·45; Flam., 2·7; Seidel, 2·6; Wollff, 2·5; Groombridge, 2·3. ζ Ursæ Majoris: Heis, 3·7; Arg., 3·3; Seidel, 3·6; Wollff, 3·6; Pickering (mean), 3·45; Flam., 3·7; Groom., 3. My own most recent estimates are—α And., 2·0; α Cor., 2·5; α Oph., 2·0; γ Urs. Maj., 2·4; ζ Urs. Maj., 3·6.—S. MAITLAND BAIRD GEMMILL.

[52002.]—**New Inman Steamer.**—The *City of Chicago* is 430ft. long, 45ft. beam, 33ft. 6in. deep, and of 5,600 tons gross. She has eight water-tight compartments, four masts, four decks, and a bridge deck 188ft. long. The saloon is forward of the machinery. The engines have one h.p. cylinder 56in. dia., with piston valves, and two l.p. cylinders 80in. dia., all having a stroke of 5ft. There are four double-ended and two single-ended boilers, working at 90lb. The ship was built by C. Connell and Co.; engined by J. and G. Thomson, and did 15 knots on her trial trip.—LONDON RIVER.

[52021.]—**Raising Lid of Iron Box.**—I would suggest a quadrant rack and pinion working within, and at one end of box actuated by means of a socket lever handle fitting on end of pinion spindle. This arrangement would, of course, entail patterns of rack, pinion, and a small bracket, the latter to carry pinion, and a small friction-roller to keep rack up to its work. The weight of lid would govern strength of rack and pinion, which would look more sightly if they were in gunmetal. It would be better, perhaps, if the pinion could be covered in by means of a case or shield, with an opening for the rack to descend through.—W.R.H.



A, end elevation, showing position of rack, pinion, friction-wheel, and handle; the latter removable, and fitting on end of pinion spindle, which should be squared. B, plan of bracket, showing pinion, rack, and friction-roller.

[52031.]—**Dynamo.**—It may please "L. O. V." to know that I have seen the same size machine as his light five 15 c.p. Swan lamps to their full power. I am sure it is a far more serious fault than a small variation of R. between A. and F.M. It is mere guesswork to find the fault without seeing the machine. Let him proceed as follows:—Disconnect the F.M. wires from the brushes, and connect them with a bichromate or other strong cell; the F.M. ought now to be strongly magnetised. The armature ought now, when the brushes are connected, to give a strong current. If it does not, you may conclude the fault is in the A. alone. Test the A. for insulation, also F.M. If the pole pieces are fastened down on an iron bedplate, it would quite account for the failure. The halves of commutator ought both to be insulated from axle, as this lessens the chance of a short circuit.—W. H. E., Coventry.

[52031.]—**Dynamo.**—If the insulations are perfect, and connections good to each half of the commutator, there is no reason why machine should not work. If the magnets are connected together at the base, it is very important that it should be a perfect fit, as magnetic continuity is very easily severed; the surfaces should be planed or scraped. If you want to use an incandescent lamp, it is better to connect the wires as for a shunt circuit, so that a portion only of current traverses the magnets. To do this, connect one wire to first brush, then round both limbs of magnet to second brush; then take a wire from each brush to lamp. You will then see that the current has two ways open to it, and to a certain extent will regulate the power of magnets. The brushes must be perfectly insulated from machine, and from one another. If the resistance of outside circuit was made equal to R on F.M., half the current would traverse each.—NO SIG.

[52034.]—**G.N.R. Engines.**—644 (Doncaster, 1880), 6-coupled goods, single frames, 5ft. 1in. wheels, cylinders 17½in. by 26in.; 678 (Doncaster, 1882), 6-coupled shunting saddle tank, wheels 4ft. 6in., cylinders 17½in. by 26in.; 30, 4-coupled (leading and driving) mixed traffic engine, 5ft. 6in. wheels, cylinders 17½in. by 24in.; 598, same class, by Kitson, 1876; 101A and 102A are a mistake, probably meant for 201A and 202A. These are single-wheel Jenny Lind engines, by E. B. Wilson and Co., of Leeds. They have 6ft. wheels, and had cylinders 16in. by 20in. They have been rebuilt, and possibly the cylinders are now 17in. dia. They have inside frames to driving, and outside to trailing and leading wheels. There was another of this class (No. 222), but it has been broken up. No. 102A is a 4-coupled (leading and driving) goods engine, double frames, built by Hawthorn.—METEOR.

[52041.]—**Brush Dynamo.**—Connect your A. up as a Pacinotti ring armature. Screw six straight bars on commutator, and connect inside end of No. 1 coil and outside end of No. 2 coil to No. 1 bar; inside end of No. 2 coil and outside end of No. 3 coil to No 2 bar, and so on all round. The R. of A. will now be equal to 3lb. of No. 16 wire. The R. of F.M. should be altered so as to equal the R. of A. The central boss is all right if it is insulated from the coils themselves.—W. H. E., Coventry.

[52046 AND 52047.]—**M.R. Engines.**—The new express engines which have lately come out from Derby (Nos. 1657—1659) have 6ft. 9in. wheels and 18in. by 26in. cylinders. They are similar to 1562—1581 class (1882-3), but I hear that the bogie has a slightly shorter wheel base. 1602—1608 are new goods engines by Beyer, Peacock, and Co.; 5ft. 2in. wheels, cylinders 17½in. by 26in.—of same class as 1582—1601. They are fitted with steam brakes. The 10 shunting tanks turned out are, I understand, similar to 1420 class: wheels 4ft. 6in., cylinders 18in. by 24in. Their Nos. are 201, 202, 210, 211, 212, 218, 219, 1397, 1398, and 1399. The last five are fitted with vacuum brake for passenger traffic. I have not dimensions of the new four-wheeled shunting saddle tanks 1322–1326. I understand they are for dock work. A new class of Midland express engines, with 7ft. wheels and cylinders 19in. by 26in., and Joy's valve gear, are being built. They will be one of the most powerful classes of express engines in existence.—METEOR.

[52055.]—**L. and. Y. Locos.**—Dimensions of both 111 and 669 classes have been given in back vols. A sketch of 669 class has also been given.—METEOR.

[52066.]—**Brazing.**—A fan driven at a high pressure may, if the air-passages are large enough, do moderate work in brazing if well managed. A fan driven by hand is about useless. The power of a blowpipe depends on the pressure of the air supplied, and with a hand fan the pressure is practically nothing. For quick brazing, a pressure of about 1lb. on square inch is necessary for the air supply. The fan made by "Cyclist" probably does not supply air under a pressure of half an ounce on the square inch; hence his failure.—THOS. FLETCHER.

[52075.]—**Legal.**—I am of opinion that the executors would be right under the circumstances in paying the legacy to the married woman, without the husband's receipt; as she is under the protection of the law, and not of her husband.—J. RUSSELL PRIDHAM.

[52077.]—**Machine Drawing.**—Have you tried drawing a machine from measurements taken by yourself: if not, I should advise you to, as this would get you into the way of drawing from rough sketches.—J. O. BRETTELL.

[52077.]—**Machine Drawing.**—Has "Engineering Student" simply been copying his drawings line for line? If he has, I should advise him to draw them to different scales; but presuming that he has been drawing to different scales, and failed to get the requisite practice, he would do well to adopt a plan which I found of immense benefit in preparing for exam. last May; let him take some machine with which he is familiar, make his own sketches and measurements, and from them make a drawing. He will find it the best practice he can have.—WEST BROMWICH.

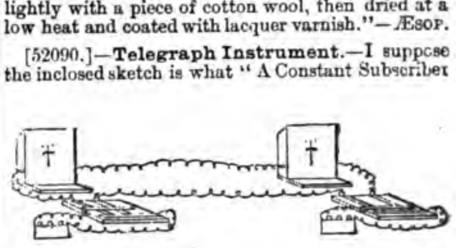
[52083.]—**Punching Machine.**—The area sheared by the punch is 3·1416 by diameter of hole in inches by thickness of plate in inches. The resistance to shearing is 3·1416 by diameter of hole by thickness of plate by shearing strength of plate. Or, as given in my work—advertised in these pages—multiply the circumference of the hole in inches by the thickness of the plate in inches, and by the shearing strength of the plate, in tons per square inch, for the power required. Thus, assuming the resistance of the steel plate to be 30 tons per square inch, we have, for the power required to punch a 2in. hole in a 2in. steel plate, the following: 6·2832 × 2 × 30 = 376·992 tons.—S. NICHOLLS.

[52084.]—**Building Society.**—The building society has not power to go outside its rules, and if there is nothing in the copy of the rules furnished to the members, stating their right to impose or enforce continued subscriptions, then they are not entitled to do so.—J. RUSSELL PRIDHAM.

[52085.]—**Building Society.**—You don't say how many shares you hold. I presume by your query that you only hold one share. You would obviously have to continue your payments of £3 with interest and expenses for 20 years before the property would be clear of the mortgage. It is uncertain how long it would be before the shares were worth £60; it all depends on the value of the land.—J. RUSSELL PRIDHAM.

[52089.]—**Frosting Tin Tubes.**—A very good way for producing a crystalline appearance upon articles made of tinplate is the following, taken from "Workshop Receipts":—"Place the article, slightly heated, over a tub of water, and rub its surface with a liquor composed of 4 parts of aquafortis and 2 of distilled water, holding 1 part of common salt, or salammoniac in solution. When the crystalline spangles are sufficiently developed, the article must be immersed in water, and washed lightly with a piece of cotton wool, then dried at a low heat and coated with lacquer varnish."—ÆSOP.

[52090.]—**Telegraph Instrument.**—I suppose the inclosed sketch is what "A Constant Subscriber and Reader" wants; it explains itself. I also inclose sketch of a switch arrangement of mine for including call bells in the same circuit. When A presses a key of transmitter, both bells ring; and when B answers, he turns his switch off of D on to E, A doing the same to his switch. After the message is sent, the switches are ret —A. LAUNDY.



[52087.]—**Pressure on Crank** determine as follows:—Areas of cy by pound pressure will equal poun pin; then area of high-pressure by steam-pressure of 62lb. at one-fourth of stroke as stated, 268·8 × 62 = 16,665·6lb. But as the stroke is only half of low-pressure one, hence half of its leverage, or half of its pressure, 16,665·6 ÷ 2 = 8,332·8, or 3 tons 14cwt. and 55lb. Then area of low-pressure cylinder will be 490·875 × 18lb. pressure = 8,835·75lb., or 3 tons 18cwt. and 99lb. By the action of the two pistons you will have a pressure of 7 tons 13cwt. and 32lb. on your crank-pin. Assuming that your crank-pin is 6in. diameter and 8in. long, there will be a pressure of 357·6lb. per square inch on pin. In the calculation of the above I am taking the low-pressure piston and air pump to form something like a balance for high-pressure piston and connecting rod, and, consequently, the transmitting power at nil. If "H. N." will get one of Reed's "Engineer's Hand Books," he will find a lot of useful information on pressure on crank-pin—in fact, everything attached to a steam engine.—FIRER, Dewsbury.

[52095.]—**Telescopes.**—"Achromatic" will find a list of some of the largest telescopes in the world, refractors and reflectors, in Prof. Newcomb's "Popular Astronomy," published by Macmillan and Co.—C. R. T.

[52103.]—**Engines.**—Thanks to "Engineer, Dewsbury," and "Labor Omnia Vincit" for answering my query. Would either of the two gentlemen help me a little further? I have always been given to understand that the number of expansions in a cylinder is obtained by dividing the length of stroke by the point of cut-off; by doing so in the above query, I can only get four expansions, and, adding two expansions for the steam passing from the high-pressure cylinder into the low-pressure cylinder, that will be six expansions. Any further information will be thankfully received by—YOUNG ENGINEMAN.

[52103.]—**Engine.**—Supposing there is no loss between the engine and the boiler, the steam will enter the high-pressure cylinder at 75lb. gross (this is the pressure at point of cut-off) and is cut off at half stroke; the final gross pressure will be 37½lb. This steam has now to exhaust into the low-pressure cylinder, and to fill half of it. Now as the low-pressure is four times the high-pressure, one half of the low-pressure one will be twice that of the high-pressure one. Hence, to fill this space, the steam must expand into twice its volume, and so become half of its pressure, or 18¾ gross. This is the back pressure in high-pressure cylinder. Next the 18¾lb. of steam in low-pressure cylinder is cut off at half stroke also, and expands through the other half of the cylinder; hence, its final gross pressure will be 9⅜lb. and vacuum by gauge as stated = 13lb., there will be 2lb. back pressure. The initial effective pressure for high-pressure cylinder will be 60 − 3¾ = 56¼. The final or terminal effective pressure will be 37½ − 18¾ = 18¾. The initial effective pressure for low-pressure cylinder will be 18¾ − 2 = 16¾; final effective 9⅜ − 2 = 7⅜. So if we divide the initial effective by the terminable effective, we shall get the number of expansions, 56¼ ÷ 7⅜ = 7·6 expansions, so you will have to cut off steam in single-cylinder engine at one-eighth of stroke nearly to get the same number of expansions as in compound engines. I should like to ask "Engineer, Dewsbury," how far the low-pressure piston will have traversed, while the high-pressure piston remains stationary to increase its volume twice, and thus become half of its pressure.—FIRER, Dewsbury.

[52108.]—**Integral.**—The given equation—

$$\frac{d^2u}{dx^2} = \frac{u}{d^2}$$

Multiplying by $2du$—

$$\frac{2du\,d^2u}{dx^2} = \frac{2udu}{d^2}$$

Integrating—

$$\frac{du^2}{dx^2} = \frac{u^2}{a^2} + c.$$

Extracting and arranging—

$$\frac{dx}{a} = \frac{du}{\sqrt{u^2 + a^2c}}$$

Integrating—

$$\frac{x}{a} = \log.\, c_1 (u + \sqrt{u^2 + a^2c})$$

Whence—

$$e^{\frac{x}{a}} = c_1 (u + \sqrt{u^2 + a^2c})$$

Resolving this equation—

$$u = \frac{1}{2c_1} e^{\frac{x}{a}} - \frac{a^2cc_1}{2} e^{-\frac{x}{a}}$$

Which is an expression of the reputed form—

$$u = Ae^{\frac{x}{a}} - Be^{-\frac{x}{a}}$$

—S. STOKES.

[52107.]—**Toning Bath.**—According to the usual computation of 1gr. AuCl to a sheet of paper, the toning bath you purchased should have contained 3gr. AuCl. It must not be supposed, however, that a toning bath can be used down to the last grain without strengthening; if you managed four or five sheets it did not do amiss. From half an hour to an hour is a good average time for toning, a much shorter time not being desirable; for not only is there much greater danger of "mealiness," but the coating of gold is much more superficial, and consequently not so permanent.—W. ROBINSON, JUNR.

[52114.]—**Painting on Glass.**—Take good clear resin—any quantity; melt it in an iron pot; when melted entirely, let it cool a little, and before it begins to harden pour oil of turpentine sufficient to keep it liquid when cold. In order to paint with it, let it be used with colours ground with oil, such as are commonly sold in colour shops.—A. W. NICHOLLS, Birmingham.

[52116.]—**Legal.**—(1) You are not liable for the rates and taxes, &c., left unpaid by the tenant from whom you purchased the business; only for trade liabilities which you took over when you bought the business. (2) If a lodger does not pay his rent, give him notice to quit; and if he has any goods distrain on them—you cannot detain them, as you have only a lien upon them for your rent. If you sell, and anything remains after paying your expenses, you are bound to return it.—J. RUSSELL PRIDHAM.

[52117.]—**Legal.**—The duty of an executor or executrix is to settle the estate of a testator according to the directions given in his will. The executrix has the power to realise the estate, and to pay all debts, claims, and demands due by the testator before the residue of the estate comes to L. It is the custom to advertise that claims will be paid by the executor or executrix, if sent in by a given time; after which time the executor proceeds to distribute the assets among the persons whose accounts have been verified. When this has been done, the rest will belong to L. and her family.—J. RUSSELL PRIDHAM.

[52119.]—**Misshapen Chest.**—"T. T.'s" son is evidently suffering from what is known as pigeon breast; that is, the ribs meet together sharply in front, and form the projection he names. It points to rickets in childhood as a rule, and now, I am afraid, cannot be remedied. Let him put his son to a less laborious employment, or even to one where he uses his brain rather than his muscles.—T. R. ALLINSON, L.R.C.P.

[52127.]—**Platinum.**—The following substances act injuriously on Pt crucibles. Metals: Alkalies, sulphides, chlorine, and phosphorus; also, lead chloride, and silver chloride, and bromide. Sulphur at a high temperature would quickly ruin a Pt crucible. The above are all I know of; probably there are many other substances to be cautious of.—METEORITE.

[52127.]—**Platinum Crucibles.**—This query has been answered lately (p. 45, present volume). The substances which must not be heated on platinum are: caustic alkalies and barium hydrate; cyanides, chlorates, nitrates; substances likely to give off chlorine or sulphur; easily reducible metallic salts or corresponding metals—e.g., silver, tin, or lead. From the fact that substances giving off sulphur are not to be heated, I presume that sulphur is detrimental to platinum.—R. A. R. BENNETT.

[52130.]—**Water Rate.**—By the 15 and 16 Vic. cap. 158, the company has the power to charge you the extra rate if they deem it necessary, and you will have to pay.—J. RUSSELL PRIDHAM.

[52134.]—**Cabinet-Making**—To "G. W. J."—The way to make a mahogany wardrobe will appear in a short time.—J. P.

[52138.]—**Copying Negatives for Lantern Transparencies.**—See last volume, p. 182.—W. ROBINSON, JUNR.

[52138.]—**Lantern Slides.**—I have lately been printing from quarter-plate negatives in gelatine, and can therefore give the information required. It is, in the first place, most important to get a suitable make of gelatine plates, as the greater part in the market are quite useless for lantern slides, although suitable for negative work. It is only recently (after trying many kinds without success) that I have come across a make which gives without trouble the requisite density of shadows and clearness of high lights. This is the Albert plate, sold by Elliott, Jewin-street, London. Exposure.—Place the plate in contact with the negative in an ordinary printing frame, and expose about one second to weak daylight (a couple of yards from a window), or about 20 seconds 3ft. from a paraffin lamp. Development.—Pyro gives a rich reddish brown tone, very effective in a lantern. I will not give formula, as everyone who has dryplate negatives to copy is accustomed to some particular formula, and had better adhere to it. I use the "Berkley" solution of pyro (with sulphite of soda). It is essential to use the smallest amount of ammonia that will bring out details, and a few more drops of dilute ammonia can be added to the developer afterwards to get density. Ferrous oxalate developer.—This gives blacker tones, but is not always so well under control as pyro. To 1oz. of a saturated solution of oxalate of potash add a ¼oz. of saturated solution of protosulphate of iron and four minims of a ten per cent. solution bromide of potassium. If unable to get sufficient density, intensify as follows:—After fixing in hypo. and thoroughly washing, soak for about an hour in a saturated solution of bichloride of mercury (which dissolves much easier with the addition of a little chloride of ammonia), wash well, and redevelop with ferrous oxalate, as described above. This gives black tones. It is, I think, the best of the mercury intensifiers; but I prefer to do without it, as the shadows are opaque and dead. I have presumed, in these instructions, that the inquirer has some knowledge of developing gelatine plates. The great point in lantern-slide making is exactness of exposure; over exposure is the general fault, and is fatal to brilliancy. If it be desired to use the wet collodion process, full particulars are given on p. 182 of the last volume. For copying quarter-plates, the camera must have a range of at least double the focus of the lens used.—A. WATKINS.

[52141.]—**L. and S.W. Engines.**—"W. B. P." will find a pretty full description of Gooch's locomotives in Bourne's "Catechism of the Steam Engine." I give a few of the principal dimensions of the "Snake," one of those made by him for the above line. Diameter of cylinders, 14½in.; length of stroke, 21in.; diameter of driving wheels, 6ft. 6½in.; diameter of leading and trailing wheels, 4ft. ½in.; total wheel base, 12ft. 8½in.; No. of tubes (181), out. diam, 1⅝in.; length of barrel of boiler, 10ft.; diameter of barrel of boiler, 3ft. 7½in.; fire-grate area, 12·4 sq. ft. Total weight: leading wheels, 8 tons; driving wheels, 6 tons; Trailing wheels, 19 tons. It has outside cylinders.—L. B.

[52142.]—**Resistance Coils.**—"Volt" cannot make his coils accurate unless he has a standard coil to balance his own against, as you cannot get two pieces of wire alike.—WATT.

[52143.]—**Chemical, &c.**

Undried Air. mm.

Height of barometer .... = 746·9

Level of mercury in trough.... = 565·9

True level of mercury in eudiometer = 317·3 + 0·4 = 317·7

∴ Column of mercury in eudiometer............ = 248·2

∴ Pressure on air in eudiometer .... = 498·7

$$\therefore \text{Its volume at } 0^\circ\text{C. and } 760\text{mm.} = \frac{292{\cdot}7 \times 498{\cdot}7 \times 273}{760 \times 293{\cdot}2} = 178{\cdot}8$$

Dried Air. mm.

Height of barometer .... = 747·4

Level of mercury in trough .. = 565·9

True level of mercury in eudiometer = 310·7 + 0·4 = 311·1

∴ Length of column of mercury in eudiometer.... = 254·8

∴ Pressure on air in eudiometer................ = 492·6

$$\therefore \text{Its volume at } 0^\circ\text{C. and } 760\text{ mm.} = \frac{286 \times 492{\cdot}6 \times 273}{760 \times 293{\cdot}2} = 172{\cdot}6$$

∴ Vol. aqueous vapour = 178·8 − 172·6 = 6·2

$$= \frac{6{\cdot}2 \times 100}{178{\cdot}8} = 3{\cdot}467 \text{ per cent.}$$

Question.—Let x° = the point on the scale of Celsius. Then the corresponding point on Fahrenheit scale will be $\frac{9}{5}x + 32$.

∴ $x + \frac{9}{5}x + 32$.

From which we get $\frac{4}{5}x = -32$

and $x = -40^\circ$ on either scale.

—SPENCER COLLYNS.

[52144.]—**Gun Query.**—If you get the gun on the muscle of the arm it is sure to punish you. When placing gun to shoulder, can you reach trigger easily? If not, I would have a bit cut off stock, which would not interfere with balance of gun, and any gunmaker would do it for half a crown. If "H." lessens the charge of powder or shot, he will not be able to kill anything at a respectable distance.—W. A. L.

[52144.]—**Gun Query.**—I think if "H." were to take a little off the toe of the gun (the lower end of stock) so that it did not hook under his arm so much, he would find it an improvement, or have one of Silver's anti-recoil heel-plates: he would then not need the toe so long, as the friction of the india-rubber will prevent the stock from rising too high. "H." must remember that the shorter he has the stock the longer, proportionately, he must have the toe for that reason.—SWALLOW.

[52144.]—**Gun Query.**—If you had the stock shortened it would undoubtedly be to your advantage, as, from reading your query, I should say that the stock is too long. The effect of shortening would be that the gun could be brought up with greater freedom and less effort, and also, it would lessen recoil. The heelplate should be bevelled $\frac{1}{10}$in. lower on the arm side, and 1oz. or more of lead put into end of stock, to restore the balance.

Any further information will be given, if required, by advertising address.—W. J. Mears.

[52144.]—**Gun Query.**—I have not the least doubt but that the inconvenience felt by "H." is owing to the stock of his gun being too long. When the gun is put up to the shoulder the heel of the stock catches under the armpit, and so rests against the arm instead of against the shoulder. I have had this experience myself, and know the discomfort of it. I believe that if the stock were shortened half an inch or so, it would come up all right, and I do not think that the balance of the gun would be affected. In using a gun it is well to get into a habit of throwing it forward to the full extent of the arms, and then bringing it back against the shoulder. By this means the stock is certain to get into its right place, and the forward action of the gun in the direction of the object most materially assists the aim.—K. W.

[52144.]—**Gun Query.**—I say emphatically:—1. Do not lengthen or shorten your stock. 2. Do not lessen your charge of powder. 3. And certainly do not pad your stock or your shoulder. In all probability the reason why you get the gunstock "upon the muscle of the arm below the shoulder" is because your shoulder is padded and is too full and convex, and also because you hold your right arm down to your side, and stand with your feet too close together. Get your left foot well out, raise your right arm at right angles to your side, throwing the elbow as far up and as far out as you can possibly stretch it, and you will never again bruise the "muscle of the arm below the shoulder," and you will find the action much freer and easier than the old one. I was trained to this position by a crack shot, and have always found it far preferable to the one usually seen in print. The left hand is the fulcrum of the gun, and should be almost its entire support, and the right hand in the position I have indicated can easily be used to press the stock inwards and keep it on the shoulder. The action of swinging the gun round to right and left is very free in this position, and is the business of the left arm. I assume, of course, that "H.'s" gun is a good one, and his cartridges are properly filled.—R. Pearce.

[52146.]—**Telegraph Wires.**—My advice to "Blackburn" is, that he should state the circumstances under which he is placed to the Post-Office authorities, and come to some arrangement with them. My own opinion of the subject is that they have not the right of user, and if it prevents you from using your property to advantage, by reason of the wires, I have no doubt they would have them so placed as not to interfere with you.—J. Russell Pridham.

[52150.]—**Poor-Law.**—If after the magistrate's order on the man to pay the weekly allowance, he has neglected or failed to do so, the wife had better go into the workhouse again, and leave the guardians to do the rest.—J. Russell Pridham.

[52152.]—**Brush Dynamo Machine.**—It is not necessary to insulate the ring from the boss. The important point is to thoroughly insulate the wire from ring, and this is easily tested with a battery. I presume "Williams" knows that the commutator in Brush dynamo is necessarily different from other kinds on account of the peculiar method of connecting coils. There should be a pair of semicircular rings divided from one another by about ⅛in., and insulated from spindle for each pair of coils on rings, and placed in relation to them so that brushes collect the currents when the coils reach the position of best action. There are usually eight coils, and magnets embrace three of them at a time. If "Williams" has made an ordinary commutator or collector, I should advise him to try connecting the coils in series as in Gramme's ring.—Light.

[52156.]—**Photographic.**—Owing to abnormal reduction of silver, which may arise from various causes—e.g., too new a collodion, too little acid in bath or developer, some organic impurity in either of the latter, or leaving developer or re-developer too long on the plate. The discolouration of cyanide is owing to your not having washed the plates sufficiently after development. It is no detriment so long as the plate is cleared within a reasonable time. It is foolish to throw fixing solutions away, as they contain a good deal of silver, which can be easily recovered by the addition of potassium sulphide. The addition of a little gelatine dissolved in acetic acid, to the ordinary iron developer, will give increased density; but in such cases as you speak of it is generally necessary to resort to mercurial intensification.—W. Robinson, June.

[52156.]—**Photographic.**—For a long time I experienced the same trouble with dry plates as you describe as happening to you with wet plates, and was quite at a loss to remedy it. The deposit was like yours, a sort of white powder, with a yellow tinge, which settled on the plate during developing. It was possible to remove it with a piece of wool; but that generally scratched the film. I was using a developer composed of solutions of oxalate of potash and protosulphate of iron, which were mixed at the time of using. At last I found that the deposit was caused by there being too much of the protosulphate of iron in the developer; accordingly, for the future, I reduced the quantity, the result being perfect absence of this defect. I should say that the cause of your failure was the same as mine—that is, if you use an iron developer, which is supposed to answer better than any other kind with Mawson's collodion. I infinitely prefer to use hyposulphite of soda instead of cyanide of potassium, to fix with, as it is far less poisonous, and quite as effective.—Machina.

[52160.]—**Battery.**—Daniell's battery is generally used for electric clocks. Some wrap their zincs in calico, others use the ordinary Daniell. About fourteen cells, I should say, in your case.—Watt.

[52160.]—**Battery.**—I was very much astonished when I beheld "Salopian's" query. I had no idea that any battery would work so long. Will "Sigma" or other reader tell me whether this battery will work electromotors, &c.? Does it work for six weeks without replenishing? At present, I am using a Daniell's 3-cell battery, but it only works the motor for an hour at a time. I don't suspend any copper sulphate crystals in a muslin bag, but simply put them at the bottom of the jar. It is absolutely necessary to keep the solution concentrated by suspending the copper sulphate near the surface of the solution? How many Walker's cells equal three Daniell's?—R. A. R. Bennett.

[52162.]—**Legal.**—The husband has no power to prosecute the grocer, as he entered the item in the bill as sugar at the request of the wife. The fraud, if any, is against the wife.—J. Russell Pridham.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, R. A. R. Bennett has replied to 51607.

51496.	To "Jack of All Trades," p. 609.
51499.	Lathe Driving, 609.
51511.	Enamelled Bricks and Tiles, 609.
51512.	Legal, 609.
51515.	Sheep Dips, 609.
51522.	Rolling Mills, 610.
51523.	Compound Loco. Engines, 610.
515x9.	Humea Elegans, 610.
51531.	Legal, 610.
51533.	Canadian Phosphate and Pyrites, 610.
51534.	Analyses, 610.
51536.	Engine Governors, 610.
51539.	Lalande and Chaperon's Oxide of Copper Battery, 610.
51547.	Turbine, 610.
51547.	Quick Return Slide-rest, 610.
515:2.	Siphon for Discharge of Flood Waters, 610.

51801.	Piercing Saws, p. 96.
51805.	Vivaria, 96.
51816.	Watch-Dial Painting, 96.
51820.	Zoology and Botany, 96.
51823.	Nickel, 96.
51827.	U.S. Locos., 96.
51836.	Alkaloid of Iron, 97.
51839.	Chemical, 97.
51843.	American Railways, 97.
51844.	Transmitter, 97.
51851.	Chemical, 97.
51859.	Fairy Bells, 97.
51860.	Roller versus Stone Milling, 97.
51867.	Bicycle Wheel, 97.

Artificial Production of Minerals.—Bourgeois has succeeded in producing wollastonite artificially by the direct fusion of the proper proportions of lime and silicic acid at a bright red heat, and allowing the fused mace to cool in the furnace very slowly. Distinct crystals and crystalline masses were obtained, which corresponded entirely in form, though not in optical properties, with the natural mineral. The same investigator also succeeded in producing an artificial melonite by fusion at a bright red heat of lime, magnesia, aluminia, and silicic acid in the proportions corresponding to the composition of the natural mineral. De Schulten has produced an artificial analcime by heating to 350° Fah., in a hermetically sealed copper vessel, for 18 hours, a solution containing the proper proportions of sodium silicate and sodium aluminate to constitute the mineral, with the addition of some lime water to aid the crystallisation of the resulting analcime. The resulting crystals exhibited the well-known trapezohedra form characteristic of this mineral—the dodecahedron and combination of these two simple forms. The chemical constitution and the optical behaviour of the artificial compound corresponded perfectly with those of the natural mineral.

QUERIES.

[52166.]—**Engine Power.**—Will any of your readers kindly tell me the h.p. of my engine with the following dimensions? Length of stroke, 16in., piston making 72 strokes per minute, diameter of cylinder 13½in., pressure of steam, 50lb. (as indicated by boiler gauge) cut-off at ½?—also when the steam is cut off at ⅜, ⅝, and when it is cut off altogether.—O. C., Bradford.

[52167.]—**Time Keeping.**—Would some of your worthy correspondents kindly give me a simple plan of correctly checking men's time in a small engineering shop? I enter the time each man commences work, but they often dispute my account, and I have to pay time I feel certain they are not on the ground. Llewellin's checking machines are too expensive. I should like to be able to make some simple contrivance. A little help will be esteemed.—Good Time.

[52168.]—**Royal National Tricycle.**—Will any of our readers give description, with sketch if possible, of the double driving gear as fitted to above machine?—viz., Lawson's friction cone clutch, with special reference to its automatic action by the steering handle.—G. S.

[52169.]—**Atomic Weights.**—Is it possible to obtain a really reliable table of elements with their atomic weights? In relabelling my bottles lately, I have experienced some considerable difficulty in adding the combining weights, owing to the various figures given in different works for the same metal. Uranium, for instance, is given as 60, 120, 240 and 59·4. Cerium is also given as 47, 92 and 138. Pray, which is the most correct? Of course, I am aware of the differences in the new and old notation, where the mysterious doubling of some of the numbers occur; but that does not explain the discrepancies referred to.—Experimenter.

[52170.]—**Midnight Sun.**—Would "F.R.A.S.," or any other reader, give the form to enable me to calculate the height of the sun above the horizon at midnight on 21 June and 21 July, say at N. Cape, lat. 71° 10′ 20″ N.?—C. R. T.

[52171.]—**Legal.**—A father, on the marriage of his daughter, settled a certain sum upon her, and handed over to her trustees a further sum to be invested for the mutual benefit of himself and his daughter, the interest thereon, in the first instance, to be paid by the trustees to the daughter towards her allowance during her father's lifetime, and the balance (if any) to be paid by her to her father. There is no allusion to the payment of income-tax, but the bank stop the full income-tax out of interest. Should not the daughter pay to her father the full balance, less only the income-tax on the balance?—in other words, should not the daughter pay her own share of the income-tax? Would Mr. Wetherfield kindly decide the point for—Fairplay.

[52172.]—**Timing of Transits.**—My transit instrument has three wires. The equatorial interval between the preceding and central wires is 2 seconds less than that between the central and the following wire. Now I want to know (1) Is not such a discrepancy as this indicative of careless or bad work on the maker's part? (2) In view of this unequal spacing of the wires, would it not be better to take star transits over the central wire alone, and not take the mean time of the three wires? (3) In order to get instrument into meridian, which is better, the method of high and low stars, or the Pole star at one of its transits?—Clock Star.

[52173.]—**Reading the Circles of an Equatorial.**—The hour circle of my equatorial is 7ft. from the floor, while the declination circle is over half a foot higher. This makes it exceedingly inconvenient, as it necessitates the jumping up on high stools or chairs to read them, while it is impossible, holding a lamp in one hand when thus perched aloft, to properly work the clamp and slow-motion screws. Would some one who has had experience tell me whether there are any drawbacks to the system of reading the circles from the eye end of the telescope by tubes and prisms? Mr. Grubb applied this method in a very ingenious way to the great Vienna refractor. I have seen telescopes as small as 6in. aperture fitted with reading tube for the declination circle, but not for the right ascension one. I presume it could be done however.—Clock Star.

[52174.]—**Slide Valve.**—I have just completed a small power horizontal engine, 2⅝in. bore, 4¼in. stroke. I tried it with steam, with a pressure of 50 pounds to the inch, and the piston would not move, but the steam came rushing out of the exhaust. Knowing it was some fault with the valve, I lengthened the rod, bringing the valve down to the bottom about ⅛in., and had the satisfaction of seeing it work excepting that too much steam escapes through the exhaust. The steam does not leave the exhaust in a series of puffs at each stroke, but comes out in one continuous stream. I have allowed about 1-16in. lead, the exhaust is ⅜in., and the two ports 5-16in. The steam enters the slide-valve case directly behind the valve, so as to keep it close to the cylinder face. Will some kind friend inform me where I am in error?—also should the valve be nearly as wide as the slide-valve case, and is there any better way of keeping the valve close to cylinder face?—One who is Perplexed.

[52175.]—**Perspective of an Interior.**—I have done an ideal drawing of an Oriental interior, but cannot get the perspective of the ceiling correct; and as no book on perspective that I have seen deals with the case, I think an explanatory sketch would be useful to others besides myself. For convenience I will make dimensions in describing. I wish to draw a room 30ft. long and 15ft. wide, one end being northwards and the other towards the south; the walls are 10ft. high, and above them is a semicircular ceiling, the pitch of which would be 7ft. 6in., and the height of the room in the centre 17ft. 6in. The ceiling does not form a "tunnel," but is quadricircular from the end wall, and this is the tough point. Now, I want to make a sketch of the room, as it appears to me when I stand at the south-west corner at a point, say, 5ft. from the south and west walls. The ceiling is ornamented by a pattern of cross bars drawn diamond-wise; this I also wish to depict, and make the joins the pattern in the corner correctly. I do not know if position of the line of sight is conditional or empiri but if the latter, I will place it at 5ft. above the floo the north wall. I do not understand algebra, and, therefore, cannot give purely comparative data. I should be greatly obliged if some one would give the rules to work out a sketch of the roof.—Murano.

[52176.]—**Light for Oxy-Hydrogen Microscope.**—Two weeks ago, I addressed a query respecting the limelight. As I am writing this from the Antipodes, it will be some weeks yet before I shall see any replies that may be kindly made to my questions. In the mean time, I have had an opportunity of reading a little work on the magic lantern by Mr. Chadwick, which contains a great deal of valuable information on the subject. My jet as mentioned in my previous communication, is one for burning "mixed gases" from one bag, and this kind of burner is mentioned by Mr. Chadwick ("Magic Lantern Manual," p. 51) as very dangerous; but I fail to see that it is more dangerous than using the gases in separate bags, for, from a paragraph a little further on, Mr. C. says that sometimes, from unequal pressure, the gases do become mixed, and accidents occur. On page 53 of the same book, there is the description of a safety valve invented by the author, and said to have been put to severe tests and never to have failed. I have no doubt amongst the many readers of the "E. M.," there are some who have had experience in burning the mixed gases and using the valve in question. Will they kindly give me the result of their experience in this matter? The valve is called the back-pressure valve, and appears admirably suited for the purpose; and should it be as efficient as stated, I cannot see why it would not be quite safe, with ordinary care, to use the gases mixed, instead of the trouble and expense of two bags.—Tasman.

[52177.]—**Outer Walls of Houses.**—Would any of your readers, connected with the building trade, kindly inform me what is the necessary thickness of outer-walls of dwelling-houses (in proportion to the height) as laid down by recent legislation for the Metropolitan district?—Leo.

[52178.]—**Combustion Without Flame.**—I remember reading that Mr. Fletcher, of Warrington, performed an experiment in a lecture, in which a jet of ignited gas was directed on some metal, and when this got hot the gas was momentarily turned off and on again, when, although there was no longer any flame, the heat increased until the metal was melted. Will Mr. Fletcher, or anyone who knows the details, give a description which will enable me to repeat this remarkable phenomenon?—Glatton.

[52179.]—**Slide-Rule Formulæ—their Construction.**—What are the broad principles on which these are constructed?—Constants for formulæ involving simple proportion I can manage; but how is the setting determined when quantities vary as the squares or roots of others, as in the following examples. I should be glad to see the successive steps which decide that the constant should be on A line, the plunger speed on B, the cub. feet on C, and the diameter of pump on D. Knowing this, of course, the constant 183 is soon found by trial. The formulæ is for pumps.

A 183
B. Ft. per min.

C Cub. ft. per minute
D Dia. of pump in inches

Glatton.

[52180.]—**Electro-Magnets.**—Would it be possible for one battery, or accumulator, to actuate a series of 70 electro-magnets in circuit, so that all would sustain the same weight? I should require them to lift about 600lb. through ½in.; but by a long lever, I could, I suppose, make a pull of 30lb. through ⅛in. do this, so about 30lb. will be the actual weight lifted. Could the current from the accumulator be regulated so as to produce any required weight of pull against an opposing spring from 0 up to maximum?—E. C. P.

[52181.]—**Balance Gear of Omnicycle.**—Could any of readers explain to me the balance gear of this machine, and how it works? I have one, but cannot understand its mechanism.—John Alex Ollard, Enfield.

[52182.]—**Coloured Inks for Bone Work.**—Will one of your numerous readers give me instructions to make any coloured ink to use with an indiarubber stamp for printing on bone, and that will not discolour or wash out? To use either on a pad or as a jelly, and also one to use with steel dies?—Bone.

[52183.]—**Legal—Settlement of Real Estate on Wife.**—I am about to leave home, probably never to return, and am possessed of a little real estate which I am anxious to settle on my wife for her life, and after her to my children, if possible in such a way that should I, which is improbable, enter into business, and say, get into debt, that it may not be affected in any way to her loss. Would it be any more certain to her if I gave it entirely to trustees, without power to sell, hypothecate, or mortgage, and for them to pay her the proceeds, such as rent, &c.? I am now entirely free of debt, and in addition to taking with me some capital for myself, would leave her with some spare cash. The trustees would be her brothers.—Schluyttdaskin.

[52184.]—**Altitudes.**—I should be very much obliged if some one would complete accurately the following altitudes:—

Upper Alt.	Ther.	Air Station	Lower Alt.	Air Station	Ther.
29·546	68·1	69·1	30·142	73·9	71·1
29·575	66·2	66·3	30·109	70·7	67·3

Latitude 50° N.—Rosicrucian.

[52185.]—**Sunspots.**—Would some one among your astronomical correspondents be kind enough to inform me as to the exact time at which the present period of solar disturbance attained its actual maximum?—I mean the decimals which will be entered in future tables as maximum of 1883.—S. M. B. G.

[52186.]—**Saturn.**—How am I to identify any satellites I may chance to see with a 3½in.? What is the smallest aperture which will show the crape-ring at all?—and the smallest which will show it properly?—*Antares.*

[52187.]—**To "F.R.A.S."**—I would be much obliged to you if you would inform me what bearing, if any, Mr. Stone's recent researches upon the length of the terrestrial day have upon Prof. G. H. Darwin's theory of Tidal Evolution of the Moon?—Selene.

[52188.]—**Lubricating Oil for Lathes.**—Which is the best?—I find sperm oil gums up. I have been recommended neats-foot oil, to which is added five per cent. caustic lime, and exposed to the air and light for a fortnight, and then filtered. Have any of "ours" tried this formula?—Cressington.

[52189.]—**Transparent Varnishes for Glass.**—Are these procurable ready prepared—say red, blue, and yellow transparent varnishes, suitable to imitate stained glass? Perhaps some maker would kindly advertise. I feel sure there are many of "ours" in need of the above.—Cressington.

[52190.]—**Copper Reduction—Wet Process.**—Being an owner of a large deposit of copper pyrites, 2 to 4 per cent., and mixed with a large quantity of iron and magnetic pyrites, and other minerals, whereby, concentration mechanically is almost impossible, I have some thoughts of experimenting by the so-called wet process, viz.—Crushing, calcining with sodic chloride, and dissolving the salts of copper by water and acid, and from this solution precipitating the Cu by electricity. As I am not thoroughly posted up in the details of this process, and believing it will interest others as well as myself, I shall be glad if any reader will, through this medium, furnish me with details and sketch arrangement.—A Norwegian.

[52191.]—**Equal Increments of Temperature.**—Are there any tables in existence giving the expansion of liquids for equal increments of temperature, and do all liquids expand equally whatever be their gravity? Any reader of "ours" will greatly oblige by assisting me to where I can find information on this subject.—J. S. B.

[52192.]—**Musical Examinations.**—Will any of our musical correspondents acquaint me with the nature (conditions, subjects, &c.) of the examinations for the respective degrees of "A. C. O." and "F. C. O."?—and also, which of the two examinations is the more difficult to pass? A few hints as to course of instruction, would be esteemed.—Would-be F. C. O.

[52193.]—**Telescopic.**—In a recent abstract of the proceedings of the Liverpool Astronomical Society, I have read with interest some observations by Mr. Franks on the performance of telescopes, and there is a point on which I should like my darkness enlightened by your able correspondent. Amongst other things, Mr. Franks says that "many celestial objects,"—Mars, Jupiter, and Saturn, are instanced—"are best seen with certain amplification, independently of the aperture of the telescope"; and he mentions powers 200 — 400 as giving the best views, not only with 4in. apertures, but giants like Lassell's reflector, and the 26in. Washington refractor. Will Mr. Franks explain why this is so?—also the apparent contradiction between the above statement and what he says in a valuable letter in the "E. M." of Feb. 23, that for planetary work a small telescope is of no use, but "a large reflector with as high a power as the atmosphere will bear"? In the abstract of proceedings, I find the Rev. J. J. Muschamp Perry remarking that "with present telescopes at least, it was not profitable to employ a higher power than 750 on any of the planets." This subject seems to me full of interest. As one of the army of very small aperture observers, permit me to ask if single lens eyepieces are so much to be despised? I have a fair 2¼in. o.g., which, with a single lens (the eye lens of a badly defining Huyghenian) gives an excellent view of both Saturn and the Moon; power about 120. Will Mr. Franks kindly tell me if is possible to see the principal cloud belt on the ball of Saturn with such aperture and power? I certainly had the impression last evening.—Arthur Mee.

[52194.]—**Finding Gravity of Light Fluids.**—I am desirous of making a set of tables for finding the gravity of light fluids with the hydrometer, but do not know how to calculate the allowance for temperature, the temperature having to be reduced to 60° from whatever it may be at the time of testing. How is this done? Will any kind reader of "ours" inform me, that I may tabulate to every usual degree of atmospheric temperature?—J. S. B.

[52195.]—**Caoutchouc.**—Is flesh-coloured caoutchouc or indiarubber ever used by doctors to supply the place of any part of the human frame—the nasal organ for instance, if it has been removed or injured in a battle or by accident? Does any medical work treat of the subject, or instance any successful cases?—Enquirer.

[52196.]—**Becquerel's Oxygen Circuit.**—Can any of the readers of "ours" inform me how to make the above battery? What proportions of caustic potash and acid are used for this battery? What kind of acid is used? The cell I have is 6in. by 4in. inside measurement. Would a porous cell do as well as a glass tube closed with a piece of linen tied over it, to which is attached a piece of clay ¼in. thick?—R. Bell.

[52197.]—**Legal.**—Would a gentleman with legal knowledge kindly give some advice in the following case? We are the leaseholders of certain property bounded on three sides—north, east, and south—by land belonging to another, the fourth side being water. Access to our holding is had by a road starting from the extreme north-east angle of the other's land, and running obliquely across his land to our inclosure, the said road having been in existence for over 50 years certain. The owner of this surrounding land has now commenced, in spite of our protests, to do away with the present and old established road, and to make another running up at right angles, due east, through his land to a bye lane. This will cause us some inconvenience inasmuch as we shall have to traverse two sides of a right angle instead of cutting across its base; and secondly, our exit will be into a bye lane instead of the high road. It will, no doubt, be a great advantage to the other party, in squaring up his land for building, &c. Query. Can this party substitute a new road for the old one without our consent? If not, how should we proceed to stop him? And finally, supposing we allow it to be done, can our ground landlord in any way call us to book for it, or hold us responsible for any damage? It is a poor estate, or I should not bother you.—A Perplexed Trustee.

[52198.]—**Firing.**—Will "Engineer" or "Firer, Dewsbury," or other reader, give a hint or two as to the best mode of firing? There is great difference between the practice of firers at the present time: Some will consume from 20 to 40 tons more than others in 12 months time.—Country Lad.

[52199.]—**Ornamental Flowerpots.**—I shall be obliged if some reader would tell me the way to make and use plaster of Paris moulds for making the pots; whether the clay is pressed into the mould, or should it be oiled? or is oil injurious to the plaster? How thick need the plaster be?—M. W. S.

[52200.]—**Vacuum Gauges.**—Will any reader give particulars as to how the new vacuum gauges that are being put in the Midland Ry. guards' vans are fixed? Also what they indicate, as I see there are two pipes leading to them?—Historian.

[52201.]—**Discharging Water from Tanks.**—I have two iron cisterns holding about 400 gallons of water each. I require to get the water out of one into the other two or three times a day. Would any of your kind contributors advise as to best way to do it? I may say it is done by using injectors—but they make the water too hot.—J. Taylor.

[52202.]—**Deed of Gift.**—What is the form for making a deed of gift? Is it necessary to have a stamp? Are witnesses required? Will it answer the purpose of a will?—A. J.

[52203.]—**Legal.**—To Mr. Wetherfield or "Lex."—A. is a dealer in pianofortes and other musical instruments, and employs B. as a pianoforte tuner under the instructions of a written agreement to the effect that when B. ceases to be under the employ of A., he is not to trade for himself as a pianoforte tuner, &c., in any of the counties in which A. has branch businesses for six months or hereafter. What I want to know is (1) whether the term "hereafter" is legal, as the term "six months" is specified? (2) Can B. set up in business for himself as a tuner, &c., in any of the counties in which A. has branch businesses, if B. is employed by another firm for six months after he has left the employ of A.? (3) Can such a restriction be legal, beyond a certain period?—Perplexed.

[52204.]—**Long Pendulum Case Clock.**—The head of case of my new clock fits so closely that the sound cannot escape. The round dial is 13in. across, and some casing fits close up to it. What should be size of case so as to insure exit for sound to be heard over the house; or what is amiss? The clock stands on floor.—T.

[52205.]—**Lead and Antimony.**—I have had occasion to make a mixture of lead and antimony—four parts of the former to one of the latter—and have experienced considerable difficulty in keeping the metal in a workable state: it goes into a pasty mass quite unfit for pouring, caused by the antimony evaporating, I believe. Will some one kindly help me?—A. C.

[52206.]—**Lever Safety Valve.**—Will some correspondent kindly tell me if I am right in the following? I have a model lever safety-valve with an exhaust hole just ⅛in. diam. When the weight is at the end of the lever it registers on a correct spring balance just 1lb. To lift the lever up right over the centre of the steam outlet, I calculate it would require a steam pressure of 3lb. to lift the valve. Is my calculation right?—A. C.

[52207.]—**Lathe-making.**—Will some of your correspondents show me my error or convince me and others of the truth of our opinion in the following matter?—I was lately engaged in the Union SS. Co.'s factory in boring out a 12in. cylinder, horizontally, on the saddle of the lathe. I was obliged to raise the headstocks 4in. higher than ordinary. This I did by placing them on wood blocks. After placing the cylinder on its "feet" on the saddle, I brought it up to the back or running-head, and as it was lined off, I set this end from the centre of the lathe, bringing up the other head to the other end of the cylinder, ascertaining, of course, that the heads were fairly opposite each other, and in a line with the lathe-bed, or shears. Thus I set the cylinder fair with the lathe and the exact heights with the heads. I was to bore with a bar having a fixed head on it carrying cutters, the saddle carrying the cylinder along. Having the bar in, &c., I brought the boring head to each end of the cylinder, alternately, and corrected it to the lines on cylinder face, &c. The foreman coming up, applied the scribing block to each end of cylinder off the bed, and found it nearly 1-16in. higher in one end than the other. I protested that this did not signify, as the bar was not moving along the bed; but the job—at that part which was being cut—was always at the same part of the bed. He grew abusive. He had been a chief engineer. Told the superintendent I was confident, but not good at explanation. I was discharged. Was I right or they? Remember the heads were fair with the lathe-bed, and that when the cutter-head was brought—or rather when the cylinder was carried until each alternate end came to the cutters—it showed fair with the lines.—F. R. Clarke.

[52208.]—**Ink for Type Writer.**—I want good ink, preferably black, for use with a Hall type-writer. The violet ink is of a very objectionable colour. The blue, and so called black, will not give a press copy unless laid on so thick as to give blotted writing. I have used a rubber-stamp ink "U.S. patent A.A." blue, but it is not strong enough. Would the addition of aniline blue improve it? In what form can I obtain it? Can a good pen ink be boiled down without spoiling it? The ink I am using is very hygroscopic, which is a nuisance.—A. P. Trotter.

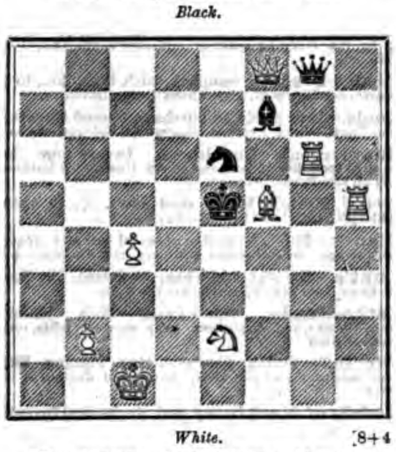
[52209.]—**Medical Coil.**—To "Sigma."—I have made a coil from the instructions on pp. 357-8 of your book, with the connections at 1 and 2, with the primary to be made at will. You say that when the connections are made, the induced currents are passed in only one direction; but I feel no difference when made or not made. I have tried some coils in which the current is felt in only one hand! I feel it in mine almost equally in both. Will you kindly say what is wrong? Might I also suggest that in the new edition an index of the tables would be a convenience?—R. P.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLX.—By J. B. Rowland ("The Wheel of Fortune") from *Land and Water*.

Black.



White. (8+4

White to play and sui-mate in eight moves.

Solution to 858.

White.	*Black.*
1. Kt to Q B 5	1. K-B 7 (*a*)
2. R-Kt 3	2. K-B 8 (best)
3. Kt-K 4	3. P mates or Kt discs. mate
	(a) 1. P (ch)
2. K-K sq	2. K-K 6 (best)
3. R takes B	3. Kt discs mate

The author terms the problem, whose solution is given above, "The Moth," and dedicates it to Mr. James Pierce.

The result of the Solution Tourney is as follows:—

First prize: Mr. C. Planck, full marks (190) "English Chess Problems."

Second Prize: Dicky Sam, 158, Pierce's "Chess Problems."

Third Prize: R. A. Bennett, 153, Miss Beechey's "Chess Blossoms."

The competitors next in order are:—

4. F. V. P.	134
5. Mortimer	108

Several other gentlemen started well in the race, among whom we may mention Messrs. A. E. Studd, Herbert Jacob, D. Mackay, and G. H. Mairwarning; but from various causes they found it impossible to go on with the competition.

We hope, now the stimulas of rivalry is over, that our solvers will still continue to send solutions, as the only real way to enjoy a good problem is to think out how it is done; and the harder the nut is to crack the more it is appreciated.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 857 by D. Mackay and J. B., of Boxford; to 858 by J. Keeble (very good), and C. Planck (a charming problem).

Dicky Sam.—Please send name and address.

Problems and games received with thanks from G. J. Slater, J. A. Miles, D. Mackay, H. F. L. Meyer, J. Russell, and J. H. Blake.

B. B.—Your solution of 856 will not do, as Black escapes by 1. K-Q 4.

J. B., of Boxford.—Sui-mates, as you say, are not chess; but they open up some very pretty manœuvring, which is *sui generis* and well worthy of attention. The one given above is of this class: with regard to the number of variations in a problem, they tend to give it *volume*, and where they branch out naturally from the main idea, they enhance its value—otherwise, certainly not.

W. Andersson.—Your solution to 856 was quite correct; we thought receipt had been acknowledged.

W. Gurney.—In your solution to 857, you have not given Black his best play. There is no mate, for instance, if he play 1. Q-Q 3 (ch).

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence at 31, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 7, and unacknowledged elsewhere:—

Crossley Bros.—D. Bannatyne.—S. Lancaster.—G. T. Morecraft.—H. Stephens.—J. W. Caulfield.—F. A. Cobbold.—Miss Hamilton.—S. Copestake.—O. J. L.—J. P.—S. M. B. Gemmill.—W. Parker-Smith.—T. Gwyn Elger.—G. Fryer. — Assistant. — Geodesia.—Glatton. - Sitrander Sahib.—Perplexed Trustee.—Equation.—Wm. Binns.– A. D. L.—Preceptor.—T. Perkins, M.A. London.—G. C. R.

B. G. (Defy the firm. Commissioner Kerr only lately nonsuited a similar plaintiff. The touting system is a contemptible one, and in no case can you be made to pay, as you are a minor.)—Bull's Eye. (The labour and trouble are proportionately greater with the small lenses; besides, questions of cost must really be left to makers and their customers, as far as we are concerned.)—W. H. Gaze. (We regret we had not the space to spare for either letter. What were the queries? We remember nothing of them.) — Achromatic. (We cannot spare the space. Ask Mr. Holmes to send it privately, or buy the book.)—L. W. D. (We are afraid you can do nothing. If you could find out certainly that a balance remained after paying all the deceased's debts, you could recover; but you have left matters too long, and had better now consult a solicitor.)—A. A. (Desirable, but hardly imperatively necessary, and might be worked up later as you go on.)—Joulad and Others. (We have no further space for discussing New Zealand. Readers have heard both sides, and must draw their own conclusions.)—Turner. (We do not think there could be any difficulty, provided you are no nuisance to your neighbours. You must, of course, give notice to the surveyor of the local board or sanitary authority of your district.)—Tanner. (Commercial matters are beyond our scope.)—Wimbledon. (See indices of recent volumes. Better have medical advice before using the coil.)—Glatton. (Whichever you like. What do you suppose a chemist would say to such a question? Does he do what you say, and, if so, what does that prove?)—J. J. Gilbert. (We do not remember the article. Letter did not arrive in time for last week.)—Thomas Plunkett. (1. You will find answers in back numbers; but the question really turns on what is the resistance of the lamp? The battery must have sufficient potential to overcome that. 2. Crossley's microphone, illustrated on p. 544, Vol. XXIX., and Edison's loud-speaking receiver described on p. 25, same volume. Most of the useful instruments have been described in the last ten volumes.)—Inventor. (The rules can be obtained from the office. We forget the exact dimensions.)—C. T. Ball. (It means just what the dictionary gives; that is, as much as the solvent will dissolve.)—C. (We see nothing to reconcile; you forget the cave is to a certain extent open to the atmosphere just as a well, at the bottom of which, especially if dry, carbonic acid is sure to be found.)—W. J. Brighton. (Impossible to answer such a question without having the context—that is, the table.)—W. H. Goy. (If you, who saw it, cannot find an explanation, how can any one from your description? The simple answer would be threads; but you do not say whether performer's hands were always over the figure.)—E. W. Newton. (Bunsen's; what you want has not been invented yet, and is scarcely likely to be. Read up your back numbers.)—J. N., Dundee. (Why not write to the patentees? If that does not meet your views, you must wait until the specification is published. We shall, no doubt, publish all particulars as soon as available.)—W. J. C. (Have we not given sufficient? See p. 426, No. 929, and sundry replies and notes since.)—T. R. Allinson. (The address of the Anthropological Institute is 4, St. Martin's-place, W.C.)—J. McE. (If the information referred to is not sufficient, it will be found by searching the back volumes, or Capt. Galton's reports in the *Transactions* of the Institution of Civil Engineers.)—Winter Night. (How is it possible to answer such a question without knowing focal length of lenses? If they are worth anything at all they are probably too good for the suggested purpose. See pp. 267, 289, 336, Vol. XXXIII., and the indices.)—Loanhead. (For full directions how to make a phonograph, see p. 157, Vol. XXVII.)—A Sufferer. (Many remedies for neuralgia in back numbers. You might try that given on p. 435, No. 929.)—J. Johnson. (They are rolled out, and the colour imparted by tempering.)—Cupidus Audiendi Est. (You will find many recipes in back volumes. Perhaps some of those given on p. 510, last volume, would suit. See p. 404, Vol. XXXVI.)—Vulcanite. (He no doubt meant Vols. XXII. and XXIII. It commenced in No. 561, and was continued for many weeks.)—Edward Hart. (You have only to take or send it to him, and pay his fee.)—Artificial Eye. (Reduce to something near a polish on a grindstone, and finish with crocus on a bit of soft wood. Very fine emery would do.)—Dairyman. (You must be examined by a medical man. Any replies would be mere guesses, and no one with a sense of responsibility would reply without knowing what is the matter.)—X. (We do not know of such a book. The information would be found to a certain extent in various works on machines, and in the volumes of the technical journals. Search the indices for clutch and coupling.)—Dick Turpin. (Rather too late to describe a thing that everybody has seen or can see. Look in your back numbers. Briefly, it is a pear-shaped glass envelope inclosing a filament of carbon describing a circular loop at its upper part.)—J. M. (We can only refer you to the advertisements.)—G. (About one ounce to a cell about two-thirds full of water. Practically, put in as much as you like, and add water from time to time.)—W. F. (It should have been well worked at the time. If stiff now, rub over with soap, damp, and work it about well.)—Semper Fidelis. (See pp. 329, 338, 361, Vol. XXXV., and the indices. 2. See p. 506, last volume, and the indices. It much depends on the cause, which can be determined only by an expert on examination. Bathing the sores with permanganate of potash solution would aid.)—Hamish. (There is a description with illustrations in Vol. XXXIV., p. 571.)—Flying Machine. (We do not know that there are any recognised dimensions. Good sizes would be 14 to 18ft. in diameter; hole about a foot in diameter, and ropes from 10 to 20ft. 2. Fleeming Jenkin's in Longman's Series of Textbooks; and Dunkin's edition of Gardner's Handbook of Astronomy, Lockwood and Co.)—T. P. M. (Answered on p. 201, No. 893. They are carefully coated with size, and then with best paper or amber varnish.)—J. H. (You will find what you want illustrated on p. 310, No. 924.)—Stanfordham. (There are a number of recipes in back volumes; but much depends on the nature of the stains. 2. The expansion of steel by heat varies slightly with the physical condition; but for all practical purposes, you make take it as ·0012 between freezing and boiling of water. The coefficient is ·000012395 for each centigrade degree.)—Thor. (See p. 273, Vol. XXXII., and the indices since. We believe the identical case can be seen at Griffin's, Garrick-street, W.C.)—B. S. S. (See p. 528, No. 907. We cannot afford engravings of such matters. You should endeavour to see one, or procure an illustrated list from the makers. Fasten the netting in groove in wood, and make the best joints you can; dovetail would be best.)—W. F. H. (The Bunsen, if it can be placed outside; the bichromate if it must be kept indoors. Directions for making both forms have been given many times.)—Poser. (We do not know where working drawings can be obtained; but any mechanical draughtsman can make them from the illustrations we have frequently given. Try if you can find one to suit on p. 272, No. 870. If not, you may by searching the indices.)—Milo. (It is not an easy matter; but you will find methods in Vol. XXVI., pp. 44, 169.)—Zither. (See a reply on p. 460, No. 851.)—Rubber. (If it is vulcanised, you can do nothing with it but sell to the factory.)—A. J. Shaw. (Nos. 942, 944, 946, 948, 950, 952, 954, 956, 958, 960, 962, 964.)—Albert Dovaston. (If you had mentioned the signature you employed, you would have saved us some waste of time. Your question was answered on p. 162 to the initials L. S. See middle column of that page, fifteen lines from the bottom.)—Mechanic. (It is in No. 749, which can be had for 2½d. in halfpenny stamps.)—W. Walker. (The paragraph appeared on p. 36. We noticed the *Times'* report, not the "invention.")—A. B. C. (Try common paraffin oil and a clean bit of rag.)—Tweedledum. (Make your battery solution of 3oz. bichromate, 9oz. sulphuric acid to the pint of water. See p. 192, last volume. 2. Metal moulds are unusual; but where a deposit is not wanted, it is only necessary to cover with a good hard varnish.)—Country Photographer. (See a reply on p. 179. No. for Oct. 26.)—W. D. (You might succeed with gas and Fletcher's radial slit burners; but vertical boilers are always best for such dimensions. You will find many hints in back volumes.)—Aeronaut. (If you could dissolve it in that it might do, but you had better try bisulphide of carbon. Better use hydrochloric acid, as the resulting chloride of zinc would be useful; the cost will depend on the prices paid; but it will be much more than coal-gas. The other question is a mere sum.)—Dynamo. (See recent back numbers.)—Stella. (One illustrated on p. 112, which will give the principle.)—A. S. L. (We hope to give the first instalment next week. Do not colour future drawings; we can reproduce them better uncoloured.)

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Every additional eight words	0	6

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O's.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills.—No amount of wealth, no means of pleasure, are of the slightest value without health. It is inconceivable how small a disturbance of the animal functions begets wretchedness, and how readily it may be rectified by a few doses of some purifying and regulating medicine, such as these world-renowned Pills, which are ever the sufferer's surest friend.

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, NOVEMBER 16, 1883.

ARE CANNED FOODS DANGEROUS?

ALTHOUGH many millions of "tins" of meat, fruit, and fish are annually used as food in this country, it is only occasionally that we hear of any fatal result from the consumption of food which is, at any rate, cheap, and, so far as trustworthy evidence is available, certainly not unwholesome. A recent case which, according to the newspaper reports, ended in death—poisoned by "nitrate of tin"—recalls attention to a subject which is not without interest from several points of view. Except for the occasional reports of deaths in consequence of eating tinned foods, there seems no reason to suppose that the use of tinned vessels is in any way injurious, and we need scarcely mention that culinary utensils of both copper and iron are invariably coated with tin, and have been so for years without any one casting so much as a hint of suspicion upon them. So far as we know, tin is not used in medicine, except in the form of filings or powder, when, mixed with treacle, it is administered in the form of an electuary, to act as a vermifuge—tin being chosen presumably because it is inert in the human economy. It is attacked by most of the common acids under certain conditions; but diluted nitric acid produces the insoluble hydrated dioxide of the metal known as metastannic acid, with the evolution of nitrous fumes; and it is not easy to conceive how, in the ordinary methods of preparing canned articles, anything could get into the cans which would affect the coating of tin to such an extent as to produce a poisonous compound. The salts of tin, too, have mostly a powerfully astringent taste, which, if they were really formed in the cans, would be sufficient to condemn the use of tin plate as a preservative casing. It is obvious, however, that tin cans as usually made must have solder about them in some part or the other, and it is not impossible that the lead contained in the solder may, in some manner not understood, be acted upon so as to become a poisonous salt; and it is possible that in some factories a little of the chloride of zinc used as soldering fluid may be left; but even in that case the quantity must be very small. An examination of an empty can discloses the fact that the tin coating has been acted upon to some extent by the juices of the meat, fish, or fruit, aided probably by the heat employed in the preserving process; but the contents of so many cans have been usefully disposed of, that it is impossible to overlook the fact that if there were anything deleterious in the can itself, the number of cases of illness soon after partaking of its contents would be vastly larger than has been recorded. Assuming that mistakes have not been made, there are a sufficient number of cases of illness attributed to the consumption of canned food to call for an expert inquiry with the view of testing the truth of the charges brought against the "tins." The question is of importance to this country for another reason than mere considerations of the food supply. We are probably not overstepping the mark by estimating that of the tin cans which reach this country, about nine-tenths have been previously exported as tin plates, which are supposed to be (and we believe generally are) sheets of iron coated with tin that is practically pure. Of the bulk of the import into America, a large portion consists of what are known as terne-plates, used chiefly for roofing purposes, in which the coating consists of an alloy of lead and tin in the proportion of 2 or 3 of lead to 1 of tin. There can be no doubt that fruits packed in tins made of such plates, especially if a high temperature were used in the preserving process, would become contaminated with lead salts, and fish and meat would also be condemned as unwholesome; but although it has often been stated that some of the more "enterprising" packers, anxious to put their goods at a lower figure, have used terne-plates for their cans, we have not heard of any authenticated case in which such a can was found when sought for. Canned articles, especially fruits, such as peaches and tomatoes, are very largely consumed in the United States, and alarming statements have not unfrequently been made there as to the danger of using canned fruits as a regular article of diet. It is just possible that the primary cause of those statements may have been the use of terne-plates; but the makers of tinware are well aware of the difference in the appearance of the bright tin-plates and those coated with the alloy, and, so far as we know, no expert has yet succeeded in finding any large quantity of lead in even the commonest tinware, and no cans which were made of terne-plates. Most of the tinplate used in the United States is made in England, and is commonly known under the designation of bright plate and terne-plate, the difference being a matter of common knowledge. Analyses have been frequently made of these plates, with the invariable result of finding that the tin coating is practically as pure as the best English bar. In one instance a trace of lead was found in the tin removed from half a square foot of plate, which would leave the tin with the character of "commercially pure"; but although lead was detected in the commonest ware, not sufficient was found to establish the charge of intentional adulteration. One analyst reports that he has been assured on good authority that terne-plate is sometimes used to manufacture tinware, but he has failed to find an instance of its use in cans for preserving food. Altogether it may be assumed that there is not much risk of eating either flesh, fruit, or fish which has been rendered poisonous by any action on the tinplate in which it has been incased, and we are, therefore, reduced to an examination of the solder. The solder-joints in any tin can consist of the vertical seam joining the cylindrical part and those at the two ends. As goods of the kind are usually packed, it may be assumed that the contents of the cans are never in contact with both ends at the same time; and as the vertical seam is generally made by the folding plan, the solder being placed only on the outside, we have only the ring seam of solder at the foot and head of the can to consider. The solder used is probably in all cases made of lead 2, tin 1; and an examination will show that only a very small surface, compared to the contents of the tin, can possibly come into contact with the meat or fish, though of course where fruit is the article, the liquid will convey the poison (if any) to all parts. The acid juices of fruit will undoubtedly act on lead, and will probably dissolve that metal from the alloy; but, like other suggestions which have been made in connection with tinned goods, no proof has been offered that lead in an appreciable quantity has been found in the contents of the cans. The latter are generally soldered up in a machine by which the minimum quantity of solder is used; and, as a rule, a guard-plate is attached to the lid to catch any solder which may run through the hole where the final sealing is made. We can conceive it possible that infinitesimal quantities of lead frequently administered may be highly dangerous to life; but it is certain that they will produce unmistakable symptoms long before any fatal result can ensue. The cases of injury or death referred to above, are, however, comparatively sudden in their effects, if we are to believe the reports, and we are, therefore, compelled to assume that if they are due to the preserved provisions at all, the cause must be sought for in the provisions themselves, or in some unknown action which they may have on the tin coating of their envelopes. When we come to consider the extreme improbability of anything deleterious reaching the human stomach in that way, for it must be remembered that long before the "canned" trade attained its present dimensions, provisions were preserved in exactly the same manner and went the round of the globe without being injured, we can only conclude that the fatal cases which have been attributed to the consumption of "canned foods" were really due to causes which must have escaped the attention of experts. Those engaged in the importation of "canned" foods should, therefore, take note of the statements referred to, and should jointly make arrangements for an exhaustive series of experiments which would determine once for all whether anything deleterious to human life can be found in the cases of tinned provisions. It may be that some unknown injurious salt of tin is produced by prolonged packing—although well-known facts negative that idea; or it may be that the methods of preserving are defective, and not equal to those which were so successful a quarter of a century ago. It may be conceded that in the case of fruit, glass jars would be better than tin cans; but in the case of fish and meat there will be a difficulty in ascertaining whether the preservative process is complete if glass is used, and a much greater loss through breakage in transportation and subsequent handling. Altogether it may be said that the charges made against tinned foods are not merely not proven; but are, in reality, highly improbable.

PRACTICAL NOTES ON PLUMBING.—LXXXV.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 210.)

NOW that we have gone through the foregoing preparatory work, which has given my readers a general insight into the art of the trade, I will give, before proceeding to my roof work, a few tables and rules suitable for inside plumber's work.

The following rules and tables will at times be found useful to the working plumber; and in order to make them as simple as possible, I will begin by explaining the law of falling bodies, which, if understood, will enable the workman to calculate the flow of water through pipes by gravitation. I shall also give rules for ascertaining the amount of friction, or loss of head of water when running through long pipes and bends; the method of calculating the amount of water a pump will throw; power required to work it, and such like. But it should be distinctly understood that simplicity is the great thing aimed at; and therefore in some cases the plain figures will not answer for theoretical work, but in all cases it will answer every purpose for the practical plumber.

Gravitation;

Or the law of falling bodies which governs the flow of water when falling through pipes (also for suction pipes).—The plumber, in order that he may tell the quantity of water which will flow through a suction pipe, or from a cistern through a given sized pipe into a w.c., &c., in a given time, should make himself thoroughly acquainted with the following rules of gravitation or attraction, or law of falling bodies:—

A body falling from a height will, approximately speaking, fall 16ft. in the first second of time; but in reality it falls 16ft. 1in., which latter in practice is not taken into consideration. Say, 16ft. in the first second of time, it will, in the second second, fall three times this distance

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[illegible] second; [illegible] second, and so on: [illegible] every successive [illegible] of which will be [illegible]

Laws of Falling Bodies.

Time of falling in seconds.	Space fallen through.	Space fallen through in last second.	Velocity acquired at the end of the time per second.
1 second	16 feet	16 feet	32 feet
2 ..	64 ..	48 ..	64 ..
3 ..	144 ..	80 ..	96 ..
4 ..	256 ..	112 ..	128 ..
5 ..	400 ..	144 ..	160 ..
6 ..	576 ..	176 ..	192 ..
7 ..	784 ..	208 ..	224 ..
8 ..	1,024 ..	240 ..	256 ..
9 ..	1,296 ..	272 ..	288 ..
10 ..	1,600 ..	304 ..	320 ..

Explanation for working the above tables. For our purpose [illegible] Suppose we have a [illegible] of vertical piping [illegible] a bullet through the pipe and [illegible] its sides. What [illegible] at the end of the first second [illegible]

[illegible]

If required per minute, divide by 60, and if per second, divide the last quotient by 60 again. Thus, 23,040 gallons per hour is 384 gallons per minute, and 6·4 gallons per second.

I may here mention that an allowance of 10 per cent. is at times made for loss by friction; but this greatly depends upon the class of pipe, and, if required in minute detail, it may be calculated by the following rules:—

$$G = \left(\frac{(3d)^5 \times H}{L}\right)^{\frac{1}{2}}$$

$$H = \frac{G^2 \times L}{(3d)^5}$$

$$d = \left(\frac{G^2 \times L}{H}\right)^{\frac{1}{5}} \div 3$$

$$L = \frac{(3d)^5 \times H}{G^2}$$

In these rules d = diameter of pipe in inches.
L = length in yards,
H = head of water in feet.
G = gallons per minute.

Then, again, there is the loss of head by bends, junctions, or branches, &c., the latter especially, which causes great eddies, more especially when the junctions are made at right angles.

Capacity of Pipes, Pumps, &c.

Question.—What are the contents of a pipe of given bore and length, say, 2in. bore and 24ft. long?

Rule.—Square the diameter of the pipe in inches, and multiply by the yards in length, and divide the product by [illegible], which will give the contents in gallons.

Example.—2 × 2 = 4 × 8 yards (or the 24ft.) = 32 ÷ [illegible] = [illegible] gallons.

Having now seen the rules of gravitation and ascertained the quantity of water which will approximately flow by gravity through different sized pipes, I will give a rule for approximately ascertaining the quantity of water which pumps of different sizes will deliver per hour.

Pump Table (Computation of).

Question.—What amount of water in gallons will a pump whose barrel is, say, [illegible] in diameter, with a [illegible] stroke, worked [illegible] times per minute, give theoretically per hour?

Rule.—Square the diameter of the barrel in inches and multiply this by the length of the stroke in inches, and again multiply by the number of strokes per minute, and also multiply by 60, the minutes per hour; now divide the product by [illegible], and the quotient will be the gallons [illegible] per hour.

Example.—[illegible]

[illegible]

Pump Barrel Proportions.

[illegible]

Pump Power, or the Power Required to Work a Pump.

[illegible]

when going up a hill he cannot do the above amount of work by, say, ordinarily speaking, about ⅔ of the quantity; but as horses do not walk in a straight line when turning a pump, it may be asked when does the horse exert its strength to the best advantage when doing circular work. From experience the circle should not be less than 40ft. in diameter, and if the circle be reduced to half, namely 20ft., the horse's power will be reduced ⅔ of the above 33,000lb.

Question.—Raise 400 gallons per minute to a height of 28ft., what power will be required.

Rule.—Multiply the weight of water, which is 10lb. to the gallon, in lbs. delivered per minute by the height to which it is raised in feet, and divide the product by 33,000, and the quotient is the horse-power.

Example.—400 × 10 × 28 ÷ 33,000 = 3·39 h.p. (For pressure to the square inch on pump bucket and capacity of barrel see examples.) But although these figures are here as 3·39h.p., it would be impossible for three horses to do anything like this amount of work in pumping water, even though they may be working in a 40ft. circle, for the simple reason that in all pumps there is a certain amount of friction, and this friction in practice becomes a serious item. Generally speaking, you may take it for granted that it will amount to at least from 20 to 25 per cent.

Pump Labour.

The following table at sight gives the number of gallons which may be raised by a man, ass, or horse to the height of 1ft. in one minute of time with the ordinary pumps, according to certain durations of work in hours, from 4 to 10 hours a day, and which is the result of practical work. For increased heights divide the number of gallons by the additional height in feet.

Table (Registered).

No. of hours at work.	Horse.	Ass.	Man with winch.	Man with lever.
	No. of gals	No. of gals	No. of gals	No. of gals
From 1 to 4	1,653	473	[illegible]	[illegible]
.. .. 5	1,480	419	[illegible]	[illegible]
.. .. 6	1,330	374	[illegible]	[illegible]
.. .. 8	1,169	[illegible]	[illegible]	145
.. .. 10	1,042	[illegible]	[illegible]	130

For the necessary sized barrel see pump table (computation of).

Manual Power Pumps.

We have seen what one horse-power signifies, and know the necessary quantity of power required to work a pump of a given size, whose duty it is to lift water to a given height. The average strength of an ordinary labouring man is [illegible] writers say [illegible] the strength of a horse [illegible] high per minute. That is to say, [illegible] powerful men [illegible] the strength of a good horse, and [illegible] the horse [illegible] the best advantage, so should the man. The horse works best when pulling in a straight level line, and is equal to [illegible] men when [illegible] with the horizon.

A man exerts the greatest strength when pulling upwards from the height of his knees, is in [illegible] from the knees upwards [illegible] winch of an ordinary [illegible] pump, and he exerts the least power when [illegible]

[illegible] as shown in Fig. [illegible]

[illegible] I am speaking [illegible] done by horse [illegible] with ordinary every-day pumps, and for the man the work done will be greater if a proportionately balanced fly-wheel be used.

(To be continued.)

IMPROVEMENTS IN GALVANIC BATTERIES.

MANY inventors have recently turned their attention to the improvement of the galvanic battery, and we have from time to time given an account of their suggestions. Lately the public has been asked to believe in sundry rather wonderful improvements: but, until we get a battery the products of which will sell for almost as much as the original materials cost, there is small chance of the primary battery supplanting the dynamo machine. Mr. Slater, of Lancaster-road, Notting-hill, has recently obtained a patent the subject matter of which will be understood from the following:—The electrolyte or cathode of a galvanic battery or a battery for storing electrical energy is formed of quicklime (say one pound) slacked by pouring thereon a saturated solution of bichromate of potash.

To that is added, little by little, nitrous or nitric acid of about the ordinary commercial strength (say 6lb.), or instead, a saturated solution of nitrate of soda or of nitrate of potash in equivalent quantity, which quantity would be about three times greater in the latter instance than in the former one, covering the vessel containing the same until the fumes evolved have subsided. In another vessel is placed caustic soda or caustic potash (say 4lb.) and water (say four quarts), to which is added dry sawdust (say 2lb.), or other suitable form of cellulose, and left until it becomes a pulpy mass.

This pulp is then mixed with the lime, nitric or nitrous acid, and bichromate of potash, and when these have thoroughly mixed chloride of sodium (say 1lb.) is added, and after the mixture has been allowed to stand for a few hours it may be placed in the desired receptacle in contact with the elementary metal or other suitable substance constituting the one pole of the battery. This substance may be a strip or strips or other form of carbon or wrought iron or other suitable metal kept in position or supported by connecting strips or otherwise. This pole and electrolyte may be separated from the other pole of the battery by a porous diaphragm or other suitable means of separation.

Within the porous vessel, or otherwise, as the opposite pole or electrode of the battery, is placed a piece of zinc, or a suitable metal coated with zinc, and this electrode is excited by placing in the vessel a mixture of caustic soda or caustic potash, chloride of sodium, muriate of ammonia, and muriate of zinc in proportions sufficient to form a neutral or saturated solution, or in proportions such as will give a reguline deposit of zinc during electrolysis. Or the muriate of zinc may be obtained by means of a saturated solution of metallic zinc in muriatic acid, and then caustic soda or caustic potash is added until the zinc is precipitated as an alkaline oxide, and upon a further addition of caustic soda or caustic potash, in the proportion of, say, 1lb. of caustic soda or caustic potash to each gallon of such precipitate, a resulting mass will be produced somewhat like thick mud, which when cold will be ready for use and capable of giving the desired reguline deposit during electrolysis. In this latter case the employment of the chloride of sodium and muriate of ammonia may be dispensed with. The salts of ammonia and zinc may be prepared by mixing them in equal proportions and then evaporating the solution into a crystalline state, and the result may be used directly with the zinc in its deliquescent state.

In the preparation of galvanic batteries, when not for use in storing electrical energy, the introduction of muriate of ammonia can be dispensed with.

The following proportions of these substances answer well: 1lb. of caustic soda, about ¼lb. of chloride of sodium, three pints of water, and a quarter of a pint of a saturated solution of muriate of zinc. To these may be added, if found desirable, a small quantity of bitartrate of potash and oxide of zinc (say 1oz. of each in the proportions of substances already instanced). This mixture having been placed in the proper vessel, it may form the charge for the battery for use until the current is exhausted.

To recuperate the exhausted cell, pass in a current from a dynamo-electric machine, or other suitable source of electricity, until the energy of the battery is again restored, and the battery is again ready for use as may be required: the action of current being to precipitate the metal held suspended in the solution on to the plate or cylinder, or plates or cylinders, from which such metal has originally been removed by previous action.

Instead of employing sawdust in the second vessel, the patentee may use sugar, molasses, or starch, carbonised by mixing a saturated solution of sugar, molasses, or starch at a temperature of about 120° Fahrenheit with equal volume by measure of nitric or sulphuric acid, and whilst the mixture is hot add thereto for each pound by weight of sugar 2½lb. of bichromate of potash or bichromate of soda, 1½lb. of oxide of chromium, and 1½lb. of freshly slacked lime, and when the whole is cool it is ready for use.

Messrs. D. G. Fitzgerald, of Brixton, and T. J. Jones, of Princes-street, Hanover-square, have also obtained a patent for improvements in elements to be used for batteries, which is thus described:—In carrying out the invention the patentees construct a tank or tanks, preferably of wood rendered watertight by means of a suitable cement. Each tank consists of one or several cells or receptacles, the number of these cells arranged in series being greater or less, according to the electromotive force of the dynamo machine or other source of electricity used in the process. Each cell may be subdivided by means of a diaphragm (or two diaphragms with the electrolytic fluid between them) of porous earthenware, felt, or other porous material. Of the two compartments thus formed, one contains the positive electrode or electrodes and the other the negative electrode. Or one of the electrodes (anode or cathode), consisting of one plate or of several plates connected together, may be contained, together with the salt or oxide of lead to be converted, in one or several porous vessels, placed within the tank; and surrounded with the other material to be converted by the electrode of opposite sign, which is in contact with such other material. In this case the porous vessels constitute one of the compartments, and the surrounding space the other compartment. The anode compartment may contain plates of lead surrounded with red lead to be converted into peroxide of lead, and the cathode compartment may contain plates of lead or carbon in contact with an oxide or insoluble salt of lead (preferably in admixture with carbon fragments), to be reduced to metallic lead. It is advantageous, except when chromic acid is to be produced, to dispense with the diaphragms or porous vessels, and to construct the tanks or cells of dimensions suitable to allow of certain elements being suspended vertically within the tank or cell along its sides so as to hang at some distance from the bottom. Upon the bottom of the tank is placed the negative element, covered to any required depth with the oxide or insoluble salt to be reduced. In this case the tanks should be shallow—*i.e.*, less in height than in breadth. The bottom of the tank is preferably raised somewhat towards the centre.

Instead of producing in bulk both the peroxide of lead and the reduced metal (obtained respectively at the anode and cathode surfaces within the tanks), the peroxide of lead is obtained in the substance of numerous plates or separate anodes of suitable size, to be employed subsequently as the negative elements in primary batteries; whilst the reduced metal alone, or in admixture with carbon fragments, is obtained in bulk, *i.e.*, in considerable masses, which are subsequently subdivided into portions of suitable size for the corresponding positive elements of the primary batteries. These anodes may be used as the negative elements of a primary battery, not only in conjunction with a positive element of reduced lead, but also, if preferred, in conjunction with a positive element of zinc in lieu of the lead. The plates, constructed wholly or mainly of lead, to be employed as anodes within the tank or tanks, should be highly porous in structure, in order that a large proportion of the lead of which they are formed may be converted into peroxide.

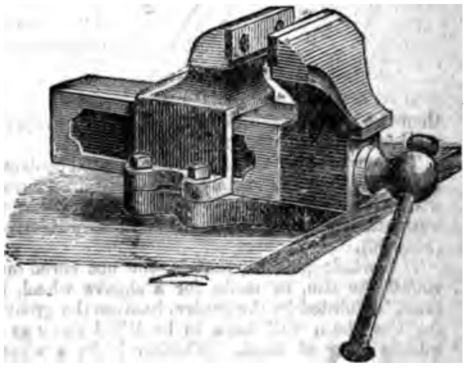
The tanks or receptacles may be connected together "in multiple arc," or "in series," according to the electromotive force of the dynamo machine, or other source of electricity employed to produce the reactions; each cell in series requiring an electromotive force of from three to four volts, although a higher electromotive force may be employed when rapidity of action rather than economy is required.

The electrolyte preferred is a dilute solution of sulphate of ammonia acidulated with sulphuric acid, in the proportion of one part of the concentrated acid to 12 or 15 parts of the half-saturated, quarter-saturated, or still more diluted solution of the salt. But in the treatment of sulphate of lead to obtain reduced lead therefrom at the cathode, the patentees sometimes employ a solution of acetate of ammonia, in which the lead salt is soluble. The cathode element, as in the case when porous vessels are used, should be lead or carbon in contact with an oxide or insoluble salt of lead, preferably in admixture with carbon fragments, such cathode, together with the material to be reduced, occupying, when a diaphragm is dispensed with, the bottom of the tank or receptacle. When a diaphragm is employed the cathode and material to be reduced occupies the whole of the negative compartment of the cell or tank.

Instead of obtaining the peroxide of lead as the material to be employed as a "depolariser" in the negative elements of primary voltaic batteries, the patentees obtain chromic acid by electrolysing the solution of a soluble chromate, such as the chromate or bichromate of potash with a platinum anode, and with a cathode of lead or carbon in contact with an insoluble salt, or an oxide of lead or tin. If such insoluble salt of lead be the sulphate, they find it advantageous to employ the sulphate of ammonia in solution with the chromate salt. The chromic acid and the reduced metal thus obtained may be used in the construction and working of primary voltaic batteries.

THE "HANDY" PARALLEL VICE.

THE annexed engraving represents the "Handy" parallel vice, a serviceable and cheap tool for both amateurs and mechanics. The body is painted and the jaws finished bright, the latter being of hardened cast steel, having faces of 2¾in. The vice will grip up to 3¼in., and its total weight is 9¼lb. Our attention has been drawn to it by Mr. A. S. Lunt, of 297, Hackney-road, E., who also sends us a useful catalogue of tools at low price.



PATTERN MAKING.—XVII.

Sheave Wheels.

A SHEAVE wheel is a wheel with a grooved or hollowed out rim for the reception of a chain or rope. We take the chain wheels first in order.

In a plain sheave the chain lies in its groove in the direction shown in Fig. 85. But a chain when in motion is always apt to twist, and when, as in hoisting machinery, a heavy load is directly dependent from it, a sudden return to its normal position will produce a jerk, and, as a consequence, a considerable extra strain will be put upon it at once. Hence it is customary where the wheel is immediately over the load dependent from the chain, and not merely acting as a carrier or support, to use, instead of a smooth sheave, one grooved out, so that the chain links may lie successively parallel with, and at right angles to its axis, Fig. 86. Further, in the differential pulley block, and in all cases where the wheel has to draw the chain along, the friction of the simple groove would not be sufficient to overcome the resistance of the load, and

Fig. 88.

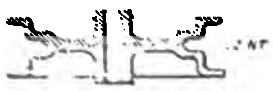
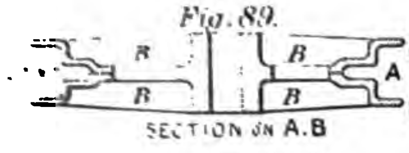
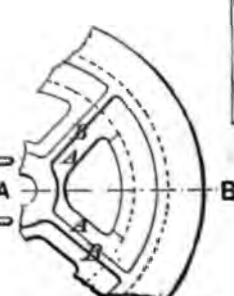


Fig. 89.





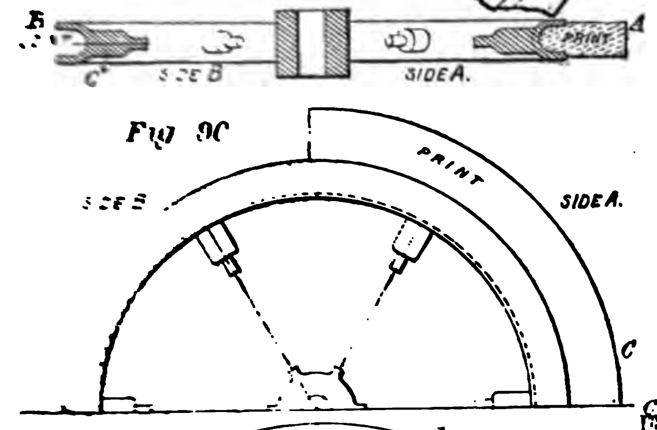


Fig. 90.

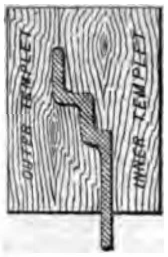


Fig. 91.

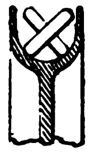


Fig. 85.

Fig. 86.

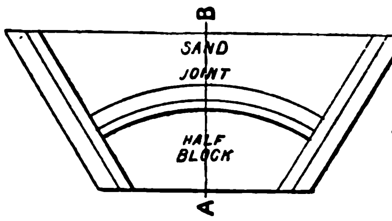
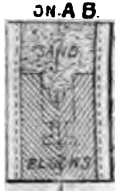


Fig. 94.

SECTION ON A B.



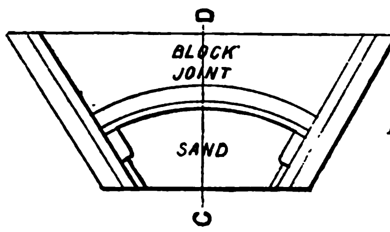
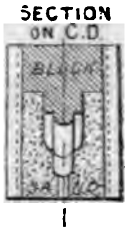
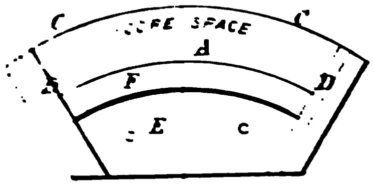


Fig. 95.

SECTION ON C.D.





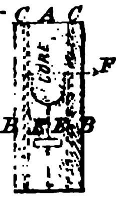


Fig. 92.

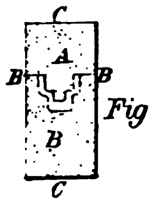


Fig. 93.

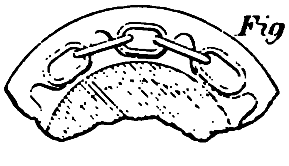


Fig. 87.

then the wheel is recessed at regular intervals to receive the alternating flat links (Fig. 87).

These wheels, if small, will have plated centres (Fig. 88); if moderately large, cast-iron arms [illegible] (Fig. 89); if very large, wrought-iron arms which will be usually strutted (Fig. [illegible]).

[illegible]

[illegible]

[illegible]

[illegible]

them. Similarly bosses and cross ribs (B B B B) will be fastened to these flat arm, having a slight amount of taper. Hollows may be put in or omitted at discretion.

Next take a large pulley with wrought-iron arms (Fig. 90). In some cases it will be advisable to use a complete pattern on account of the number of castings demanded. The ring could then be made in the usual way by building up in two halves and jointing (Fig. 90, side marked B). The bosses with their prints (C) on the inside of the ring will be jointed also. This would answer very well where the wheel is of stout proportions. But if it were light in section, such a pattern would not bear foundry usage very long, and an iron pattern would be advisable. But another method would be to build up a solid ring with a broad print (Fig. 90, side marked A), and to take out the groove with segmental cores—say ten or a dozen to the circle (Fig. 92, A). The advantage here would be that without making an iron pattern, we should have a rigid rim, not liable to become rammed out of truth—a matter of importance in a wheel of any kind. And further, although there is the additional expense involved in the making of the cores, we also save as a set off against this the trouble of the middle part box, since, instead of the joints top and bottom, we only want one joint at the top face of the print.

The core box will be made thus—Two sides will be prepared (Fig. 92, B B). Their outer edges (C C) will be worked to the same radius as the outer edge of the print (C). The inner edges—straight—will extend about a couple of inches below the line which represents the bottom of the wheel groove. In these sides, cut grooves (D D) ½in. deep, radial from the centre of the wheel, and at a distance apart, equal to the intended length of the segment of core; a 6th, 10th, or 12th of the circle, as the case may be. Into these grooves drop distance pieces of the width necessary to keep the sides at their proper distance apart—that is, equal to the thickness of the print. Then fit a couple of blocks (E E) between these sides and ends, parted longitudinally down the centre of the box. Work their edges F to the same radius as the rim of the wheel, then mark on their ends the rim section. Cut out the groove thus marked with templet very truly, so that when the cores are made and laid end to end, they shall correspond neatly, and not show a lapping joint in the casting. When worked, replace the pieces in position, and screw them, one to each side of the box. It only remains to put on the bosses for the arms, and to make the central boss with its prints precisely as in the case of a flywheel with wrought-iron arms.

Where the arms are strutted to give rigidity to the wheel, the bosses on the rim have to be bevelled alternately in opposite directions, and the prints on the central boss bevelled in like manner. These latter, too, in a strutted wheel should be *pocket* prints, and not round ones; for round prints would necessitate two joints in the body of the boss, coinciding with the centres of the prints, while with pocket prints the joint on the top face of the boss is alone required.

There is yet a common way of making a large sheave wheel without a pattern at all. A glance at the sketch (Fig. 93) will indicate the method to which I allude. The light portion is the wheel rim in section—the dotted parts indicate two cores, one outer (A), one inner (B), forming outside and inside of rim respectively. It is seen that these cores are jointed at B B. Of course the joint must be a curved one—both cores being worked to the same radius. The outer edges of the cores (C C) need not be curved at all, because they form no part of the wheel. Give sufficient sand there, say two or three inches in the narrowest part, and some lesser amount, say 1in. to 1¼in. at the sides.

To make these boxes, proceed thus—Frame sides and ends together for each respectively. Their ends must converge to the wheel centre, and must either cut through the centre of an arm boss or midway between two bosses. Thus, if the wheel have eight arms, there must be either eight or sixteen cores. Assuming there are eight cores, we have a half-boss at each end of the inside box. The boxes must be equal to each other in width, which will include width of rim and of two sand joints. Then blocks will be fitted between these boxes, as in the last example, those forming the wheel *groove* will be worked out by templet to the shape indicated in Fig. 94, The general principle of "telpherage" traffic is to send an almost continuous stream of small weights along a light, cheap line, instead of (as in railway traffic) sending a few large weights along a heavy and expensive line. This stream can be regulated by an automatic blocking system operated by means of two or more light telegraph wires run from post to post. The effect of this system is to check a following train if it approaches a preceding one too closely; maintenance is reduced to a minimum, whilst the automatic character of the whole system reduces the attendance necessary for the good working of the line to the engineroom, and the points of loading and unloading, as no driver or guard is required on the trains themselves.

To the uninstructed spectator the electric locomotive appeared to set itself in motion and drag its train along without any controlling power. It was in fact started from the engine-room or testing-room in the farmhouse. The locomotive consisted of a small electric motor about a foot long and six inches in diameter. This, on being brought into connection with the electric current, which was generated by a dynamo machine driven by a steam engine in a shed, revolved with great rapidity, and communicated its motion to a simple wheel, which in its turn caused two wheels, which gripped the wire rope, to revolve, and thus pulled along the train. The train itself consisted of cradles suspended on the wire rope, which was supported on rough posts, and each cradle would, perhaps, carry 100 or 200lb. weight. The wire rope on the posts serves both to carry the train and to conduct the electric power, which can be taken off at any point along the line and applied to other purposes than that of moving a train. This was illustrated by a small electric motor fixed to one of the posts at a distant point. This motor, having a current of electricity drawn from the overhead rope sent through it, easily worked a cake crusher, thus showing that it may some day be possible for the farmer to turn machines in the sheepfold and at other points of the farm, and even to plough his land, by power generated at the homestead and conveyed by a simple wire to any point where it may be wanted.

PAPER BOATS.

WE mentioned some little time ago that the Westinghouse Company had been making experiments with a launch made of paper, the object being to provide a light boat, bullet proof, and capable of carrying the new high-speed engines designed by Mr. G. Westinghouse. Some years ago Brown, the sculler, came over here with a wager-boat made of paper, and when Hanlan paid his first visit to the Tyne he also brought a paper "shell," and practised in it on the river, but neither Brown nor Hanlan thought enough of the devices to pit them against the usual cedar boats in a rowing match. The paper "shells" we need scarcely say are an American invention, the original patent being granted to Messrs. E. and G. A. Waters on June 30, 1868; but though they do not appear to have been a success, owing to the fact that the necessary strengthening timbers made them heavier than the modern racing boats, paper has been used with some satisfaction in the construction of skiffs and canoes. We glean much of the following information from the *Paper World*, of Holyoke, Mass. — A wooden model is prepared in exact form of the desired boat, on which the paper skin is moulded, sheet after sheet being superposed one upon another until the desired thickness is obtained, the boat which we saw in process of construction being composed of nine thicknesses of strong Manilla paper, making a thickness of about ⅛in. In preparing the paper the lines of the boat are carefully drawn out to its full size, and the paper which comes from the mill in rolls, similar to that which is made for printing on perfecting presses, is cut to the full size desired for covering the entire length and breadth of the boat, so as to leave no joint or seam, or perforation of any kind. For racing shells the best Manilla paper is used, but for gigs, dingeys, canoes, and skiffs, paper made from unbleached linen stock only is used. In manufacturing the racing shells, the first sheet is dampened, laid smoothly on the model, and securely fastened in place by tacking it to certain rough strips attached to its upper face. Other sheets are now superposed on this and on each other and suitably cemented together, the number depending upon the size of the boat and the stiffness required. If linen paper is used, but one sheet is employed, of such weight and dimensions that, when dry, it will give just the thickness of skin necessary. Should the surface of the model be broken in parts, as in the case of boats with square sterns, for instance, the paper is made to conform to these contours by suitable concave moulds, which also hold the paper in place until, by drying, it has taken and will retain the desired form. The model, with its enveloping coat of paper, is now removed to the drying room. As the paper skin dries all wrinkles disappear, and it gradually assumes the exact shape. Finally, when all moisture has been evaporated, it is taken from the mould, an exact *fac simile* of the model desired, exceedingly stiff, perfectly symmetrical, and seamless. When the skin is removed, the boat, as it then appears, is waterproofed, the frame and fittings completed, and the boat varnished. The advantages possessed by these boats over those constructed of wood are strength, stiffness, durability, and being without joint, lap, or seam, to admit of leaking by strain or shrinkage; they have no grain to crack or split, never shrink, and, paper being one of the best non-conductors, no ordinary degree of heat or cold affects them, thus rendering them admirably adapted for use in any and all climates.

The crowning glory of the paper boatbuilding business by Messrs. Waters and Sons, although an experiment, bids fair to be as successful as have been their efforts in the building of racing shells, canoes, and the like. This experiment is the construction of a steam launch or pleasure yacht, to be propelled by one of the celebrated Westinghouse steam engines, built at Pittsburg, Pa., where the boat is now lying for the purpose of receiving its engine and accompanying equipments. This is built of different material, and the method of construction is also different from that of the smaller boats. Unlike them the entire skin constituting the boat is formed the full size of the launch—it being twenty-five feet in length, necessitating the making of the skin in two halves, which are joined together on the keel. For this purpose two moulds, each representing one-half of the proposed paper launch, running length-wise, are built by logging up layers of clean pine. On building the two moulds for this launch, upwards of 3,000ft. of timber was used, in order to give great solidity to resist the tremendous pressure of the shrinkage of the paper. When these moulds are worked off to the exact lines required, the sharp edges are protected with ⅛in. boiler iron, which completes the moulds ready for the paper. This paper, which is made by Messrs. Crane Brothers, of Westfield, Mass., comes from the mill in one wet sheet of the required shape about ⅜in. in thickness afterwards drying to $\frac{3}{16}$in. The sheet is enough larger than the mould to admit of turning over the edges, where they are screwed and clamped to resist the process of drying. A flange is turned over the edge of the inner face, extending its whole length, by which flange, when the hull is completed, the two halves are bolted together. When this first layer of paper is dried to the required form, it is coated with asphalte, and another similar layer attached to the first, making the total thickness of the skins ⅜in. When these skins are taken from the moulds they are the perfectly-formed halves of the launch. These two halves are attached to the two halves of the keel, which is made of wood, and all firmly bolted together throughout the length of the keel, and the seam is subsequently made tight by the usual process of caulking. The tube for the shaft is cut through the wood only, and is cut in either half before putting together on the line necessary to connect with the engine. When these two halves of the hull are bolted together along the keel, the gunwales and deadwood are put in and attached to the keel, and the hull is complete. Ribs necessary to carry boiler, engine flooring, &c., are then put in, being suspended from the gunwales and resting on the keel, not, however, in contact with the paper. The finish consists in smoothing off the paper, which admits of a polish equal to the finest cabinet work, oiling and drying in hot kilns and painting in colours to suit the taste. Experiments have demonstrated that this paper, even with the paint entirely worn off from it, and if possible torn and gouged into, so that a mere layer of the thickness of a sheet remains, will still resist the action of the water.

The Westinghouse Engine Co. having made a special application of their engine for marine purposes, for which it seems peculiarly adapted, have built a number of boats this season which have proved to be very fast, and have also made a number of heavy engines for towing and pleasure steamers, and their success in this line has induced them to try the experiment of having paper boats constructed in which to introduce and use their steam engine, which, although of comparatively recent introduction to the mechanical world, has already won for itself an established place in the front rank of the many steam motors now in successful operation.

NEW METHOD OF INSULATING TELEGRAPH WIRES.*

HAVING had occasion for a year to apply, for the decoration of articles of jewellery, the procedures pointed out by Nobili and Becquerel for obtaining coloration by means of baths of alkaline plumbates and ferrates, I observed that the articles thus coloured became absolutely proof against all galvanic action: that is, their surfaces, when once coated with peroxide of lead or of iron, were insulated, and no longer conducted the electric current. A wire of copper, brass, or even iron, may thus be coated with an insulating layer like a stratum of resin or guttapercha. This principle, I believe, admits of easy utilisation in preparing wires and cables for use in telephony and telegraphy. The method of obtaining this insulating stratum is, from an industrial point of view, very practicable, and the cost trifling. The hardness of this coating, which resists all atmospheric action, is a guarantee of its durability. The insulation is absolute. The method of preparation is very simple. A bath of plumbate of potash is prepared by dissolving 10 parts of litharge in 1,000 parts of water, to which have been added 200 parts of caustic potash, and boiled for about half an hour. It is allowed to settle, decanted, and is then ready for use. The wire to be coated with peroxide of lead is attached to the positive pole and a small platinum anode to the negative. Finely-divided metallic lead is precipitated upon the negative pole, and the wire is coated with peroxide of lead, which passes successively through all the colours of the spectrum. The insulation is complete when it takes a brownish-black colour. The wire thus covered is perfectly insensible to electric action. Articles perfectly cleaned may be attached to it, and connected with the negative pole of a gilding, silvering, or nickeling bath without the current, however powerful, producing any action upon the objects to be coated. Such a wire, if placed in a circuit, and brought in contact with another wire in connection with a galvanometer, leaves the latter entirely unaffected.

LIVE DUST.

ONE of a series of "Lectures to the People," given under the auspices of the Yorkshire College, was delivered at the Philosophical Hall, Leeds, by Professor Miall, last Monday, the subject being "Live Dust." Professor Miall commenced by referring to the mode of collecting dust for examination, especially dust floating in the air. A glass slip smeared with glycerine had been extensively used for the purpose of collecting the dust; but this method was open to the objection that all germs were killed by the glycerine, and that the volume of air which had yielded the dust could not be measured. Water shaken up in a large flask of air had been used to separate the dust, but by this means a sufficient volume of air could not be examined without using a vessel of inconvenient size. Atmospheric moisture, condensed upon the surface of a vessel cooled by ice, had been collected and examined. The modern instrument for passing a measured current of air through a fine jet, and scrupulously collecting all the dust which it contains, was described in detail, and illustrated by means of lantern slides. Proceeding to point out the various kinds of dust found in the atmosphere, the lecturer spoke of volcanic dust, minute particles of magnetic iron (believed to be microscopic meteorites), the dead organic matter which forms a large proportion of common dust, and living organic dust. Of the last named the chief constituents are pollen, spores of moulds and mildews, and bacteria. The bacteria, he observed, were of special interest from their connection with putrefaction and with certain deadly diseases. It was shown long ago by Schwann that bacteria were indispensable to putrefaction, and that the most unstable organic fluid would not putrefy unless living bacteria obtained access to it. This demonstration ultimately led to Lister's antiseptic surgery. The life-history of some common bacteria was described, and an account given of the way in which a necessary connection between particular forms of bacteria and infectious fevers had been ascertained. The great number of bacteria everywhere present in the air made us feel that we were assailed by the germs of disease at every point. But two or three practical considerations might be shown to greatly diminish the risk. In the first place, the bacteria of disease formed only an insignificant proportion of the whole number of living germs present in the air; further, a great number of the bacteria of all kinds were dead, not more than one-twentieth being capable of germination in a suitable fluid; and lastly, the putrefactive and other less dangerous bacteria were very prone to get the upper hand of the more special and delicate organisms which constituted the germs of infectious disease. Practical remedies with regard to the dangerous forms of dust were explained, the principle of these being the use of antiseptic substances, the removal from the neighbourhood of large towns of dangerous trades such as created quantities of dust or involved putrefactive processes, the simplification of household furniture, and especially the doing away with any very elaborate woollen hangings in houses, the multiplication of grass spaces, improved cleanliness in streets, and complete detachment of the air of dwelling-houses from possible contamination with sewer gas. No public body and no individual who was careless about dust could possibly be careful about health; and he thought, [illegible]

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*By M. C. Wiedemann in Comptes Rendus.

[illegible] notice of the work of the Selenographical Society has appeared in these columns, and that, like him, I regret the disappearance of selenographical matter from [illegible]. For this latter circumstance there may be two reasons, unnoticed by your able correspondent. In the first place, a large proportion of the matter was contributed by Mr. Birt. I am [illegible] that no contributions made in the "E. M." to this science, can be more valued by astronomers than the long series of papers and sketches which bore the signature of "C. Gaudibert", but these communications have become infrequent. A second reason may well be this—that much of what is now being published concerning selenography is so extremely technical as to be almost useless to those who are not furnished with a specialist's store of authorities. We cannot all be members of the Selenographical Society. We cannot all possess the works of Neison, Lohrmann, Beer and Madler, Schmidt; the "Selections," &c. In writing for specialists, selenographers cannot hope to be followed by those who are not specialists. But selenographical specialists are few in number. Again, there is a want of readily accessible direction as to what should be done. Valuable as they are, the "District Catalogues" in the *Astronomical Register*, are but unsatisfactory substitutes for "Telescopic Work for Moonlight Evenings," "Lunar Physics," and "Lunar Work." In thus neglecting to provide for the wants of observers less ambitious, or possessing smaller instruments, or commanding comparatively little time, selenographers are depriving themselves of much willing and valuable assistance. Concerning the specialisation of astronomical work, another remark may be made. In this most tantalising and tormenting climate it is [illegible] to limit ourselves to a single class of observation. For my own part, I know this, that I am compelled just to observe what I can see; there is very little use of my making up my mind to observe any given object on any given occasion. This circumstance is no doubt due in some measure to the locality of my point of observation in relation to the [illegible] part of this great manufacturing city. Mr. [illegible] recently remarked in "ours" upon the differences between different portions of the sky in the same evening. I can fully confirm what he said, and I always account for these differences on the assumption of drifting films of smoke. Anyone who does much in the way of estimating star magnitudes is bound, of course, to keep a look out for films and haze, wisps of smoke, or anything else which can tend to dim the light of the star under observation. So that, if I cannot observe one thing, I just observe another, and I think that [illegible]

[illegible]

found any fluctuation in the course of my own observations, I wrote to Mr. Proctor, who replied, "When I wrote that it had just been discovered that γ Cassiopeiæ is variable." Afterwards, I found γ Cassiopeiæ classed as a variable star, along with β Lyræ, in Roscoe's "Spectrum Analysis," edition 1869. My copy of "Spectroscope and its Work," is dated 1877. Neither Mr. Espin nor Mr. Franks can give me any information upon the subject; both these gentlemen knowing nothing of γ Cassiopeiæ as a variable star. I would much like information; perhaps Mr. Knott or Mr. Sadler can give it, or Mr. Baxendell. Mr. Proctor's word establishes that he had good grounds for his statement, but it is, nevertheless, singular that nothing can be found in the place where one naturally looks for information upon the variability of stars. Referring to the extract from Smyth's "Cycle," given by "F. R. A. S.," I must say that Sir John Herschel's words seem to me to have reference to the variability not of γ but of α Cassiopeiæ.

ϕ and χ Draconis.—I have reason to believe that one or other of these stars is variable, or (and more probably) that both are so. Last year they were practically equal, and about 3·9. This year they are separated by nearly one magnitude, χ being 3·7 and ϕ 4·4. On the 1st and 7th October χ was reckoned 3·6, on the 15th 3·7, and on the 21st again 3·6.

What a magnificent spectacle the sun has presented within the last week! On the 11th October I counted eleven great and complex groups, and there were, besides, several smaller single spots to be seen. We have had boisterous weather, and are now, in common with the rest of the country, having a heavy gale. I suppose the sunspot meteorologists would connect these facts; but I do not know what to think, having failed, in my reading of the newspapers, to find any accounts of that succession of desolating hurricanes with which, were the theories referred to absolutely and universally true, the world must have, considering the stupendous disturbances which during its course have taken place upon the sun, this year been visited. In saying this, I assume that effects are to be expected to be proportioned to causes. Perhaps Prof. Archibald or Mr. Westwood Oliver will give us some information upon the phenomena of *general* meteorological change within the past six or eight months. I ask in no carping or sarcastic mood, but in a spirit of impartial inquiry. I have no belief in the extremist doctrines held upon this matter, but am desirous of obtaining information which will throw light upon the more moderate ones. Did any consequences follow upon the tremendous and magnificent phenomena exhibited during June and September which were in any degree proportionate to their magnitude?

Saturn is a splendid object in the telescope at present. On the 23rd, about 14h., the air being pretty clear, and definition at intervals very good, I had a beautiful sight of it. Ball's division was visible, by snatches, all round; and the Crape-ring could be seen where it crossed the disc. The rings were a fine yellow. The equatorial zone of the planet was a pale whitish yellow. The principal belt was seen to have a very decided edge on the northern border, and to be of a pale cinnamon. To south of that was a paler zone; and to south of this, again, another dusky belt, its duskiest portion in the centre. I suspected that between this and the polar regions there was another whitish belt, and that it was ill-defined. This morning (26th October) about 2 a.m., conditions fairly good, I noticed that a portion of the chief belt seemed to be darker than the rest, and to have something of the appearance of a dusky spot. Observing Jupiter, between five and half-past five, I observed the brilliant equatorial spot. It was distinctly brighter than any other part of the disc; and roughly, though not quite, on the following side circular. It was preceded by a projection northward from the southern equatorial belt, which was distinctly the darkest marking visible. I used a 3¼in. achromatic (o.g. by Wray), power 145. Mars is in Præsepe—an exquisite sight.

I enclose two lunar sketches, pencil copies from views taken at the telescope. One is of the Mare Crisium, and was made upon the 18th; A is a small bright mountain which cast a short pointed shadow. It is, it appears, the centre from which one of the smaller ray systems which compose the ray system of Proclus issues. (Has anything been done recently with regard to the ray system of Proclus?) B points out two curious ridges. It will be observed that they do not run in a north and south direction, and are not parallel to the mountain border. They are distinct, but have the appearance of inclosing a space. C is the ridge east of Picard. D was a crater and very bright. E was a crater: it appeared, from the shadow which it cast upon the mountain ridge, to have a peak upon its south-western corner. The other is a sketch of Plato, and was taken about 17 hours on the 23rd. It is interesting, as showing the spots 1 and 17 as cones. Had the air been better, I have little doubt that I could have made out more detail upon the floor, for I seemed repeatedly to glimpse other markings. Considering what is said as to their delicacy, the cones were very easy—obvious, indeed, they were—with the 3¼in. The power used was 145. Is A a cleft or a valley? I suppose B is Schröter's χ.

S. Maitland Baird Gemmill.

Glasgow, Oct. 26.

P.S.—I observe in the reply on p. 225, that Ursæ Majoris has been printed for δ Ursæ Majoris.

JUPITER'S RED SPOT.

[22037.]—It may interest your readers to know that on Friday morning, Nov. 9th, at 4.30 a.m., I was tempted out by the sight of a clear sky to have a look at Jupiter, and found the great red spot about an hour past the central meridian; but I was surprised to see that its *form* and colour remain much as they were last April, when I took my last sketches of this object. The red spot is still partly imbedded in the southern equatoral belt, and the colour has certainly not faded since last April, being still of a light pink, and very discernible. My great aperture (18¼in.) will account for the ease with which I see this remarkable object, but it certainly would be visible in much smaller instruments. I mention this because, if I am not mistaken, it has been reported as being now quite invisible.

Jevon J. Muschamp Perry.

St. Paul's Vicarage, Alnwick.

JUPITER, MARS, SATURN.

[22038.]—Although for many days past here on the Dorset Hills, some 700ft. above the sea level, we have been more or less enveloped in mist and clouds, yet there have been a few hours of magnificent observing weather. On the morning of Oct. 26th, from 5 to 6 the mist lifted a little, and I had a splendid view of Jupiter and also (for the first time this season) of Mars. The snow at the North Pole was plainly visible, and also some dusky marking between it and the equator. Powers used—300, 500, and 600, on an 8½ Calver mirror. This planet will now evidently repay the trouble of observation after midnight.

On Oct. 28 the sky was for a while clear, and I saw the comet Pons; there seemed a bright nucleus with a diffused nebulosity round it; but Nov. 1, from 9.30 p.m. to 12 p.m. was the best night for definition we have had for some months. γ^2 Andromedæ was decidedly elongated with a power of 600, and Saturn, even with this high power, was sharp, clear, and steady. Cassini's division was a sharp, dark line, almost meeting above the planet's ball. The shading on the middle ring towards the crape ring was beautifully seen—the crape ring a lovely object. Encke's division, I am almost sure, I saw in the midst of the delicate shading of the outer ring; and the wavy edge of the upper side of the bright equatorial belt was well seen. The shadow of the planet on the ring seemed to terminate abruptly at Cassini's division. I tried several powers, and the beautiful definition (even with the highest) speaks volumes for the perfection of the mirror and the steadiness of the air. Clouds, however, unfortunately came up before Jupiter had risen above trees to the east of my observatory, and since then observation has been out of the question.

T. Perkins, M.A.

Shaftesbury, November 5.

DELTA CYGNI.

[22039.]—Mr. Holmes (p. 192, No. 971) asks whether "J. C. R." is sure he perfectly divided δ Cygni with 4½in. aperture. In reply, I beg to say that star was clearly divided with my 4½in. equatorial refractor on the 13th Oct. (moon 12·6 days old), by Mr. J. C. Ryan, myself, and a friend who is quite unaccustomed to astronomical observation. I have also perfectly divided it on a dark clear night, although I had understood that twilight or the moon was necessary to divorce it. The green companion was remarkable by its brilliancy and great contrast with the orange yellow primary.

Lake, Sandown, I. of W. **Wm. Binns.**

EQUATORIAL STANDS.

[22040.]—The suggestion of "Vigilans" is a good one. There are no doubt many mechanical amateurs who would be quite able to make a plain yet efficient equatorial stand if they had a plan to go by, and detailed instructions for carrying it out: I have, therefore, made drawings to a fairly large scale of two stands, adding also certain variations which may be adopted, if preferred.

The first illustration, Fig 1, is intended to show how the ordinary "pillar and claw" form may be altered into an equatorial, while Figs. 2 and 3 are modifications of it. Fig. 4 is a different stand in many respects, though the arrangement of the declination axis is intended to resemble that in Fig. 1. Commencing with Fig. 1, it is intended to utilise the pillar of the ordinary stand by making it rotate on a strong fixed axis (preferably of steel), which axis is secured into the upper surface of the foot marked *a*. This foot is a circular block of brass forming the base of the whole, and itself secured to

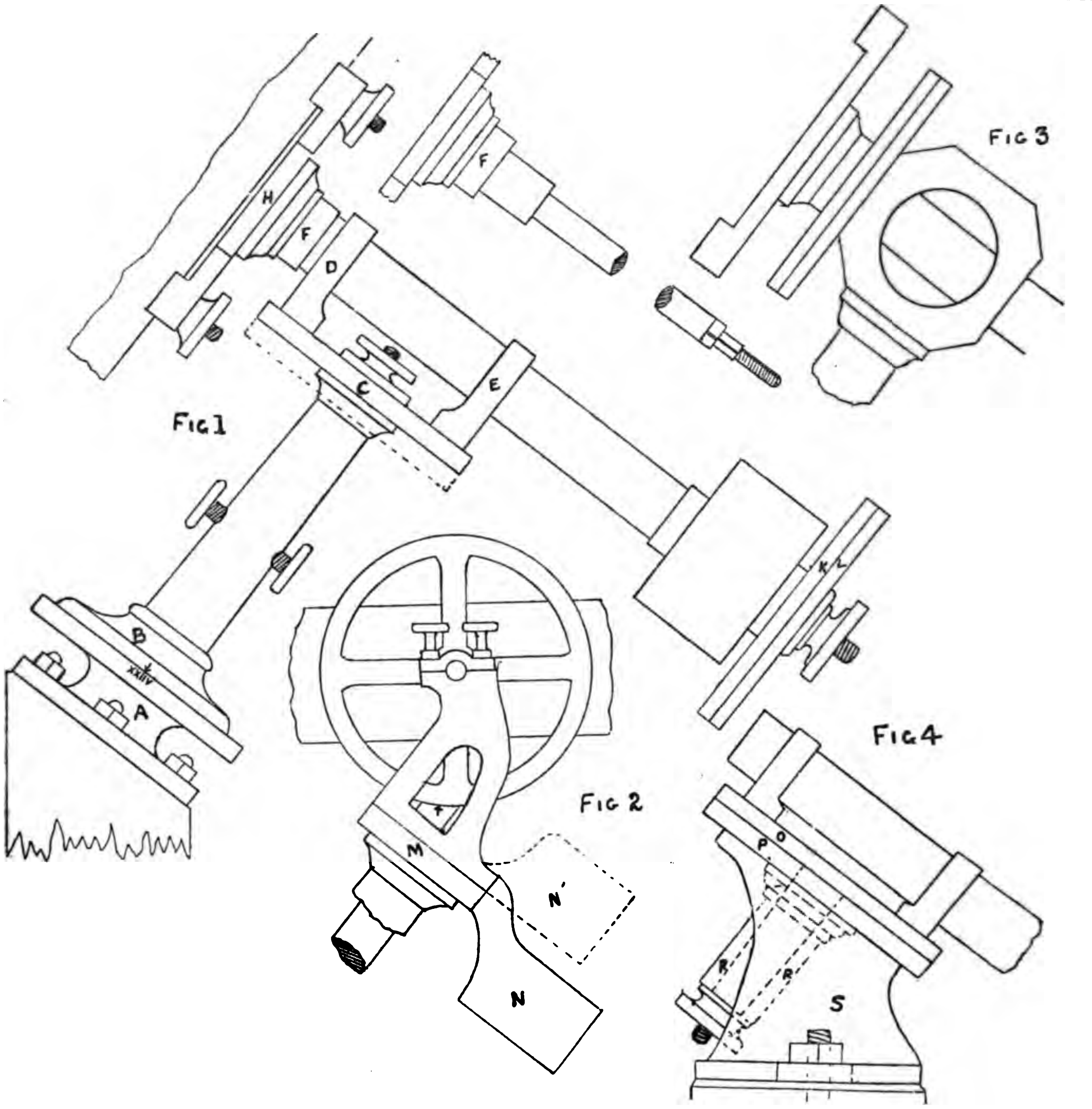


FIG 1

FIG 2

FIG 3

FIG 4

protractor, can be mounted on the *flat* of the disc instead of the strips round the edge; but it is less easy to manage. As regards the declination circle matters are less easily arranged, owing to the difference in value of a minute of arc, which, being the $\frac{1}{60}$th of a degree instead of $\frac{1}{4}$, is an extremely minute fraction of the circumference. For this reason it is usual to make the declination circle larger than the hour circle, the minutes being read off by a vernier, which is also used in better-class instruments for the accurate subdivision of the minutes of time. It is, of course, a question for the amateur to decide for himself *how* large his hour and declination circles shall be; but they should not be *less* than those shown in the drawings. I have before me a protractor divided to ½ degrees, but the marking is eye-straining to follow. The diameter is about 5¾in., so I consider 6in. or 6½in. the smallest that can readily be used without a vernier and magnifier.

Recurring to the hour circle, I may explain that it is not *necessary* to divide the circumference into degrees: it will suffice to divide it into the 24 hours *only*, if we have a corresponding arc divided into degrees, the length of such arc being equal to that between two hour divisions on the hour circle. This arc may be on the fixed or on the movable disc, according as the hour circle itself is movable or fixed. Suppose the degrees are marked 4, 8, 12, and so on up to 60: then when (say) the hour line X. is opposite the 0, or zero, degree, the reading is Xh. At the first degree the reading is Xh. 4m.; at the second degree Xh. 8m., and so on till the X. hour line coincides with the degree marked 60, when the XI. hour line will coincide with the 0, and read XIh. 0m. Thus, with 24 divisions of the hour circle, *and a short length (only $\frac{1}{24}$ of the circumference)* divided into degrees, we get as complete readings as if the whole circle were divided into degrees. I believe this to be novel (at least I have never seen it proposed before), and it will save amateurs trouble and expense. The same principle is applicable to the declination circle; but for this I think the complete division into degrees and the reading off of the minutes (or 10-minute intervals) by an ordinary vernier is best.

Let us, then, try and tackle this graduation business once for all. An amateur is not wont to be beaten if his heart is in his work, but this is certainly a tedious and difficult job. I have made divers trials with compasses and "stepping," also by repeated bisections; but even with delicate instruments and extreme care I have never succeeded in satisfying myself, and cannot recommend the method.

Another way is to purchase a cardboard protractor, cement it down on the plate to be divided, and then with a straight-edge and fine graver mark off the divisions. This is fairly accurate if care be taken to get the centres of the protractor and disc coincident, and to hold the graver always in the same position. A diamond may be used instead of the graver; but the lines come out very fine—more like scratches.

I have seen a disc in which the divisions were etched in by acid, the original dividing being cut through a thin film of etcher's wax. The result was bad in every way: ragged, coarse lines and irregular spacing. The best way I believe to be this: There is sold at the Ordnance Survey publishing office a very large circular protractor (I think about 15in. or 18in. diameter, but I have not used one for some years), engraved on very stout millboard (or rather cardboard). This is to be securely fastened to a flat board, and a circle marked on it concentric with the graduation, and of a *slightly* larger diameter than the disc to be divided. This circular centrepiece is then to be cut cleanly out with a proper cardboard cutter, fixed, if preferred, in a strip of wood pivoted on a stout pin.

The disc to be divided is then dropped into the central hole. If the disc is thicker than the protractor, the latter must be packed up on a ring of card or thin wood, or *vice versâ* if it is thinner, the essential condition being that the face of the protractor shall be flush with the surface of the disc. Two fine silk threads are next stretched across (forming two diameters at right angles to each other) from 90° to 270° and from 0° to 180° and the centre of the disc adjusted to their intersection. The disc is then secured in position by three slender wood screws—an operation requiring much care to avoid shifting the disc.

We may next strike with fine pointed compasses two or more parallel circles to determine the length of the hour and minute lines; also of twenty minutes or half-hour lines, if intended to be specially marked, which they should be.

We next require an accurate steel straight-edge of a length to reach entirely across the protractor. Against this is slid to and fro a little block of boxwood, or brass, carrying the point of a graver (like a miniature plane, in fact) to cut the division marks.

The graver point will evidently be removed a short distance from the edge of the straight-edge, and would, therefore, cut a line parallel to, instead of coincident with, this latter. It is, therefore, necessary to attach to the straight-edge, at the part where it lies over the graduations of the protractor, two narrow strips of boxwood or brass of the exact width that the *centre of the graver* is removed from the edge of the straight-edge.

It now only remains to place these strips to coincide successively with the divisions of the protractor, and then cut in the mark on the disc with the sliding graver point. If an inner and outer ring be marked to show where to move the graver *block* up to, in order to arrest the graver *point* at the proper places, the lines will be cut of even length, which makes the work look far better than if this is neglected.

This method is only applicable for dividing a flat surface; for an edge or rim divided circle I know no easier (or, for an amateur better) way than to divide by a scale and compasses a strip of brass, and either use that as the actual graduation, lapping it round and fixing it to the edge of the disc, or using it in a similar way to mark the edge of the disc itself. It is easiest to use a disc whose circumference is an exact number of inches, as in the case of the hour circle with the cardboard scale round its rim. Many circles are bevel-edged; but I know of no way of dividing these suitable for an amateur.

The next section will deal with slow-motion arrangements and clamps, and this will bring me to the end of the constructive details, and leave only the fixing to be dealt with. **A. S. L.**

TO MR. BRASHEAR AND "BOW."

[22041.]—Mr. Brashear has my best thanks for the information given on the heliostat mirrors. I always read his letters to the "E. M." with the greatest pleasure, and am glad to find that my *short* and very simple essays afford him some instruction and pleasure too. I wish I had time to be more extensive; I, however, do what I am able, and am well supported by my two fellow writers. Theoretically and practically, I am sure that Mr. Wassell and Mr. Bradbury are doing much towards the enlightenment of us all. Mr. Wassell's experiences and painstaking in watching for and reducing to figures every detail, cannot be too much valued. It is a work that no practical optician has time for who has hard business to push through, and yet it is needed to insure progress. Mr. Bradbury's essays are very complete compared with all I have seen; I am astonished at the perseverance and determination displayed by that gentleman, for I know something of the difficulties in the way of anyone employed in such a search as his has been.

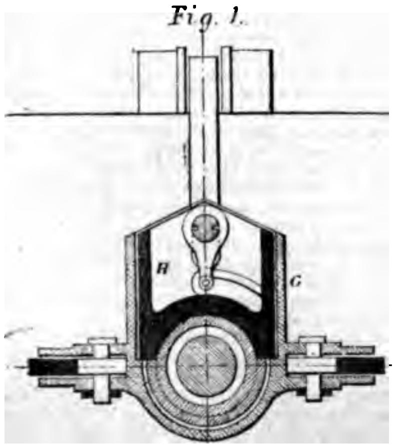
I hope "Bow" will not think me thin-skinned, or that my feelings were (h)arrowed (no pun). I hope we shall not come to that in the "E. M."

That which "Bow" states was certainly the case —viz., that there was not much trouble taken about the form of the curves so long as the complete o.g. was up to the mark. In looking back, say, 20 years, I can see how very much the old workers must have depended upon chance. Of course, it was never the practice to have a stock of *large* o.g. lenses. One pair was worked upon until a satisfactory result was obtained. I am prepared to say that all opticians use as a basis theoretical curves, *very much* modified by practical experience. As to practice and theory being jealous of each other, I really must differ with "Bow." I do not think there can exist a closer friendship. I did not intend unfairness to Newton; still, his experiments must have led him to theorise. I reverence the great name of Newton. **Prismatique.**

THE PARKER-SMITH BRAKE.

[22042.]—Several correspondents having lately expressed a desire that I should illustrate my Automatic Screw Brake in your valuable journal, I have now much pleasure in sending you some small drawings and a rough description.

Fig. 1.



SECTION THROUGH PART NUT

On one axle of each vehicle is mounted a screwed sleeve, formed in two halves, which are bolted together: this sleeve does not touch the axle, but rests on two bearings as shown, Fig. 1. A part-nut (H) is contained in a cast-iron box, G, and is raised and lowered so as to engage with, and be disengaged from, the screwed sleeve by means of a cam arm and spindle. A friction cone C D (Fig. 2), when forced together by a cast-iron ring of metal, A, on one side of which are inclined planes acting against inclined planes, joined on the side of frame, causes the screwed sleeve to revolve with the axle. The force with which the screwed sleeve revolves depends on the downward pressure applied to a lever projecting from the ring. The travel of the part-nut in either direction spreads abroad the arms I I, (Fig. 3), and pulls the brake blocks against the wheels.

Fig 2.

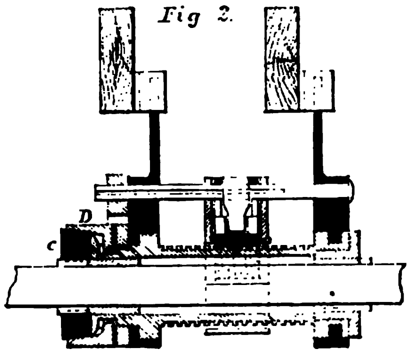


Fig. 3.

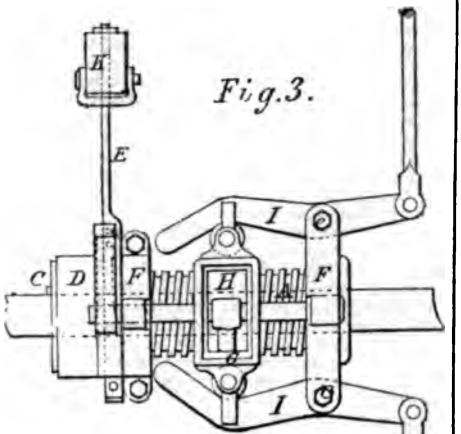


Fig. 4.

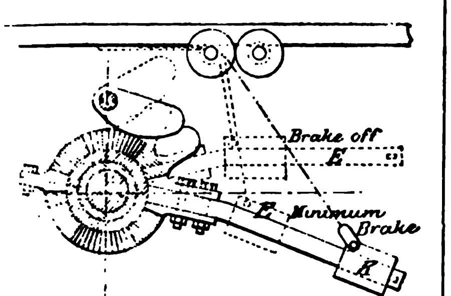
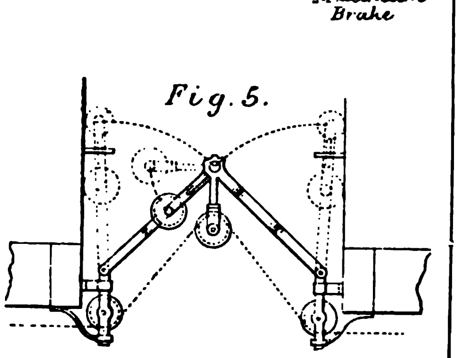


Fig. 5.



The action of the apparatus is as follows:— When the lever is held up to its higher position, the part-nut is clear of the screwed sleeve, and the friction cones are not in contact. When the lever E (Fig. 4) is permitted to descend to its lower position, the part-nut engages with the screwed sleeve. In this position if the weight K is permitted to slide down the lever, friction is produced in the cones, and the screwed sleeve revolves, causing the part-nut to travel either to the right or to the left, according to the direction the vehicle is travelling, thus making the side levers put on the brake as before described. As soon as the desired braking power is obtained, the weight is hauled up along the lever, thus removing the friction between the cones; the brake remains *on with the apparatus at rest*.

To take off the brake the lever is lifted to its higher position, which by means of the spindle and cam, lifts the part-nut clear off the thread, and it springs back to its central position on the screwed sleeve by the tension of the brake rods.

Fig. 5 shows the method used for connecting the brakes together, so as to use them as a continuous brake.

By this arrangement there is no movement in the continuous connections due to vibration in the length of train, height of carriages, &c., for it will be seen that the movement of the vehicle merely alters the angle formed by the three pulleys, and, like a pair of compasses, altering the angle does not alter the length. This has been the great difficulty with all continuous connections hitherto, and I may safely say that the arrangement I have designed effectually disposes of this difficulty.

It will be seen that this arrangement secures simultaneous action, and braking power throughout the train, for whatever length of chain is let out by the engine-driver, each weight along the train immediately descends the same distance, and produces equal effect on the apparatus it controls. The weights I am using are 10lb., and this is ample for a 12-ton vehicle at high speed, the power of the apparatus being so great.

I was led to design this brake after many years' experience on railways, and opportunities of witnessing the many defects of air and vacuum systems, and noticing that all fluid systems were supplemented by a mechanical screw brake, I came to the conclusion that if this mechanical screw brake, on which so much reliance is placed, and with which failure is unknown, could be made continuous, a powerful, reliable, and cheap brake would be at once obtained.

W. Parker-Smith.

MICROSCOPIC MOUNTING.—III.

Resinous and Air Mounting.

[22043.]—Here we have to describe (I.) the appliances, (II.) the materials, and (III.) the process of mounting.

I. *Appliances for all mounting.* These are:—

1. A *spirit lamp*, or a *Bunsen burner*. Ordinary lamps, candles, or gas unmixed with air give a smoky flame, which may spoil slides; the spirit lamp need not be a large one. For ordinary purposes the flame should be very low; it may be stoked up and down with a mounting needle.

2. Two or more *mounting needles*, which are stout needles broken short, and shafted into old wooden penholders, from which they project about 1in. or rather less. The hole may be made with the point of the needle, the broken end being afterwards firmly cemented into it, *e.g.*, with a glass cement, or with gold size. They are cleaned, as often as used, with pure water, or, if they have touched Canada balsam or other resinous substances, by putting them into the flame of the spirit lamp till it burns blue again.

3. *Glass tubing* of soft glass, and ¼ or ⅜in. external diameter (rather larger for dipping tubes). By putting a tube across the spirit-lamp flame, and drawing it out as it softens with the heat, dipping tubes, stirring rods, a rod for Canada balsam, and capillary tubes or tubes with fine rods or capillaries for endings, may easily be made. To close the end of a tube, and so make a rod, hold the end of the tube in the lamp, work it close with another, and heat well. To smooth a sharp end so that it will not cut the lips, hold in the lamp, and, if necessary, work with the end of another tube (or with a mounting needle to keep it open), cut into convenient lengths (say, 4in. for a Canada Balsam tube, or 8in. for a dipping tube), with a rat-tail file, or simply draw out in the lamp, and break.

4. *For Dissecting.*—One pair of *steel forceps*, 4in. long, with *rounded* points $\frac{1}{12}$in. broad or less, grooved internally so as to hold better, coming into contact with little pressure (2oz. or so). There should be no stud near the object end fitting into a hole; but the blades ought to be broad to prevent overlapping. One pair of small *elbow scissors*, with one of the points very fine. Two *holders*, like crochet-needle holders, for dissecting needles, which are stout short needles, ground so as to have three sides, the point being sharp, and the angles formed by the three sides capable of effecting a certain amount of cutting (glovers' needles). Small knives

may also be made of needles shafted into penholders, and then ground. Two or more knives, shaped like scalpels, with blades 1in. or so long. A similar knife, with a blade *very much curved [illegible]ward*, for cutting down on glass, or wood, or cork, to cut sections into shape, &c. For the dissection of larger objects there is nothing better than an ordinary medical student's dissecting case, with three scalpels, a pair of straight scissors, a larger pair of forceps than that described above, a blowtube, and a chain for holding objects, or, better, some dissecting pegs. A number of different kinds of fancy knives are sold; but the only other kind which will be really useful is a small knife with a blade whose edge is a straight line, so that an object does not slip away from the point when cut down upon. But none of these things should be got before they are really wanted; and the pair of forceps first described are alone necessary for mere [illegible].

5. A pair of [illegible] scales, with weights from a grain to four drachms, capable of weighing two grains with tolerable accuracy. Weigh a grain or two of paper, cut it into equal portions, and see how the scales turn with small fractions. Get the seller to explain the marks on the weights. Keep the whole dry; and remember that it is safest to weigh on paper.

6. A measuring-glass, measuring from half a fluid drachm to a fluid ounce—if larger, the half-drachm mark will probably be grossly inaccurate. Test it when buying, by [illegible] drops measured in a large measure; and notice where [illegible] drops come to in your larger measure.

7. The following — [illegible] A deal board to lay on the table for working on. A newspaper may be first spread out double as additional protection. The board I use is [illegible] by [illegible] it need not, of course, be exactly of that size. Some [illegible] or other boards, to raise the board in the dissection, so as to bring the object nearer the eye without stooping. [illegible] A [illegible] and [illegible] for filtering. The latter may be got from a chemist (Swedish paper), or made of white blotting paper. The paper should be loosely doubled (i.e., the finger-nail should not be used to make it double very sharply, as it may then run into holes) into a half-circle, and this again doubled across into a quarter circle. Two pockets will then be left, into one or other of which the liquid to be filtered should be poured. If the liquid is [illegible], pass clean water through the filter [illegible] which it is always to get rid of the [illegible] and [illegible]

[illegible] camel's hair pencils, which have been [illegible] to be put into a glass of water [illegible] slides and covering glass [illegible] watch-glasses [illegible] and [illegible] which are most useful [illegible] reagents employed in preparing them [illegible] and for crystallising [illegible] well in so thin a layer as can be put on a slide without running. [illegible], cut from any glass by a glazier, large enough to cover the lids of the pots when the lids are turned upside down. These may be used when, in [illegible] with gold, it is necessary to act on the object by light. A small object, moreover, may be put on a pot or lid, with only a drop or two of fluid. It might be difficult to find it again if a larger quantity were used. Circles are the best [illegible] will cut them, on being given a lid to measure by. Have the tumblers with wide tops, so that they can be inverted over a lid with a [illegible], to protect from the great enemy, dust. Additional protection will be given if a bit of velvet is glued to the rim of the tumbler [illegible]. It will be well for the tumblers and [illegible] to be of the same pattern as those used in the house. Cold fish [illegible], small, containing a pint and a half or so of water, are also useful for keeping small animals in, but the *shape* is not so convenient as that of a wide-rimmed, flat-bottomed tumbler. [illegible] bottles, especially wide-mouthed bottles, and [illegible] especially if stoppered, [illegible] small boxes, in which [illegible] may be kept, and preserve pots [illegible] of the form [illegible] cylindrical, the top [illegible] the underneath part, so as to facilitate [illegible] small objects [illegible] *test tubes*, which ought to contain nearly a fluid ounce [illegible], an ounce [illegible] measuring glass), and may be covered with paper to protect them from dust when holding anything. [illegible] to stand them in, and holders to hold them by when used for boiling. [illegible] be made after being seen. In [illegible] test tubes, move [illegible] of the spirit lamp, so [illegible] the heat on one part of the glass. The outside must be quite dry, and so must [illegible] tubes with the lamp [illegible] If the liquid boiled does not boil [illegible] clean and introduced will [illegible] be cleaned with a [illegible] with cotton linen or [illegible] sold. (*h*) [illegible] of different [illegible] and strengths, [illegible] *employed for pressing down the [illegible] glass on the slip. They are sold at 1s6d. [illegible] the same [illegible] tubes), or may [illegible] after having been seen. They are better* without cork, which is apt to become messy from Canada balsam, &c. (*i*) A *cupboard* or *closet*, in which these and other things may be kept, having a lock to prevent their being interfered with, and a close-fitting door to help in excluding dust. But the microscope ought not to be kept in the same cupboard, and must not be exposed to the vapour or action of chemicals.

II.—*M[illegible] for Resinous Mounting.*—For the actual mounting itself, gum dammar, Canada balsam, or chloroform and Canada balsam will be required. Procure about an ounce and a half of Canada balsam in a wide-mouthed corked bottle of such a size that the balsam fills two-thirds or three-quarters of it. Canada balsam is a semi-fluid gum resin, composed of a turpentinous essential oil, which gives to it its peculiar fragrant odour, and of, at least, two resins, one of which dissolves in alcohol, while both are soluble in chloroform, ether, turpentine, benzene, oil of cloves, and many other substances. Water renders it opaque, and the bottle which contains it, and everything which touches it, ought, therefore, to be quite free from moisture. It should be perfectly transparent and free from dust or specks, and great care must be taken to keep it so, the bottle being kept covered with paper. It gradually dries and hardens by evaporation of its turpentinous constituent or constituents, and the resinous matter contracts, but remains transparent when in thin layers, though it becomes brittle. It is by this evaporation taking place at the edge of a covering glass that the balsam beneath the cover of a mounted slide hardens and permanently fixes the cover and the object in their place; and from the same cause balsam kept in a bottle becomes gradually stiffer and thicker. When first bought, therefore, it may be almost limpid, and it is then unsuitable for mounting, as although the actual process of mounting is easier, the subsequent drying and hardening of the slide are very slow and tedious. Heat renders it more liquid for the moment; but increasing the evaporation renders it afterwards harder and more tenacious, so that to stiffen it it may be left, with the cork loosely covering the bottle-mouth, in a warm but not dusty place, the bottle being carefully covered with paper to exclude dust. The harder it is, moreover, the greater is the amount of heat required to make it sufficiently liquid for mounting, and the more difficult is it to exclude air-bubbles. Many delicate objects will not bear heat, but curl, contract, or blacken under its influence; and the combined advantages of dispensing with heat, or with more than very moderate heat, and of having a mount which will solidify more quickly, may be secured by adding chloroform to a portion of stiff old Canada balsam liquefied by heat, adding till the mixture is, when cold, as thin as fine oil. This may be labelled "Canada balsam and choloroform," and ought to be kept in a stoppered bottle to prevent the evaporation of the chloroform. Both the Canada balsam bottle and the chloroform bottle should be wide mouthed (say, 1¼in.), so as to admit of the introduction, without risk of messing the inside of the bottle-neck, of a small glass rod, by which a drop may be taken out and conveyed to the slip in mounting. If the neck, cork, or stopper are messed they will be likely to stick; they may be loosed by warmth, with the addition, if necessary, of a little turpentine round the edge, wiping the turpentine carefully off again before taking out the stopper or cork, so as to prevent it from entering the bottle. It is well, in order to prevent small particles of the cork from becoming detached and getting into the balsam, to cover its sides and under surface with linen glued to it, and afterwards saturated with turpentine. The bottle should be carried upright, so as to prevent the contents from messing the sides, neck, cork, or stopper. Gum dammar, or dammar resin, Kauri or cowdie gum, the produce of an Australian tree, is prepared for microscopic use by picking out the best pieces, dissolving in benzole to an oily or syrupy consistency, and straining. The solution is also sold. It may be thinned with benzole, dries very rapidly, and is said to be apt to crack. Other gum resins, such as balsam of copaiba (which dries very slowly), solution of copal, &c., may also be employed: but for resinous mountings I would recommend anyone to stick to stiff old Canada balsam, and Canada balsam and chloroform, and to try other media only where those fail. New media are continually coming into use, and as constantly go out of use again. They may appear to succeed in the hands of their introducers, perhaps because they take special pains with them; but till they have been employed for many years, it is impossible to say how they will behave in the long run. They may preserve an object beautifully for a year or so, and then, gradually changing, ruin it.

In mounting anything resinously, *i.e.*, in Canada balsam, &c., it is necessary previously to deprive it of the water which it contains. To effect this it is in some cases sufficient to let it become perfectly dry by exposing it to the air, either freely or with crystals, and other inorganic objects, or between two slips, as the epidermis of a plant. But most substances, if "dehydrated," or deprived of their water by simply drying them in air, are spoilt, so that it is necessary to dehydrate by immersing them in a fluid which will subtract their water, and at the same time support their delicate structure, and fill out their parts to their original dimensions. After they have been cut into sections, stained, or otherwise prepared, the more delicate of the objects which it is intended to mount resinously are consequently immersed in methylated spirit, which is used in this country instead of rectified spirit, because of the Excise regulations. It costs tenpence or a shilling a pint, is indispensable to the microscopist, may be kept in a corked bottle, ought not to be allowed to touch any varnished surface, such as a polished table, and should be as strong as it can be procured, and free from dust or sediment. It is well, by the way, to tell any chemist, in buying anything of him for microscopic purposes, of the special use to which it is to be put, since a little moisture or dust in the bottle or the measure would be of no importance in the ordinary way of business. If the spirit has to be filtered, the filter, should it have been previously washed with water, ought, of course, to be allowed to become quite dry before used for it. Methylated spirit is employed, not only for dehydrating, but also for cleaning slides, for the lamp, for hardening objects which when fresh are too soft to cut into sections, to preserve specimens or parts of animals afterwards to be used microscopically, and as an ingredient in many recipes where, because of its cheapness, it is employed instead of rectified spirit.

But methylated spirit contains a certain amount of water, so that some other substance has to be used as a bridge between it and the balsam. Of these, ether, commonly called sulphuric ether, has no advantages except for removing air. It is expensive, and vaporises with extreme rapidity, so that the object is apt to be left dry. However, it is indispensable in microscopy as a solvent for removing and thus detecting the existence of fats and oils, which it dissolves with great rapidity when they are fairly exposed to its action. It should be purchased in small quantities of an ounce or so at a time, and kept in a closely stoppered bottle covered with parchment paper or washleather. Chloroform is another indispensable substance, but too dear to be used for completing dehydration: it is employed for killing small animals, for preventing putrefaction, and for making the Canada balsam and chloroform solution spoken of above. It slowly decomposes when not under water, even in the dark; may be kept in a corked, but better in a stoppered bottle: and, like the other reagents spoken of in this paragraph, must be perfectly free from water. This may be known by the absence of water-globules and of dulness of the fluid. Benzole is more active than turpentine in cleaning Canada balsam away, and, as it evaporates more quickly, is preferable for varnishes; but it is very inflammable, has an abominable smell, and is more expensive than turpentine. It is variously called benzole, benzol, benzine, and benzene, and is C_6H_6, a hydride of phenyl, usually impure, though its impurity does not seem to be of any microscopic importance. Turpentine (by which I mean not what is called "fat oil of turpentine," but ordinary turpentine or spirit of turpentine) is useful both for cleaning and for passing objects into from spirit before they enter Canada balsam. Like the other substances, it clears them or renders them more transparent: but it is apt to make them contract or curl up, which oil of cloves is not so likely to do; and though the latter is more expensive, much less of it is required, and it acts more rapidly.

III. *The Process of Resinous Mounting.*—Having selected the objects for mounting, clean them, and clean a few covering glasses as directed for slides, but more delicately. Take a fold of the clean old silk handerchief between the finger and thumb, and dry the covering glasses by inserting them in the fold, and rubbing them, using the pulps of the fingers. Clean a few centred slips also, and cover all up till the moment of use, to protect from dust. Take a slip, and drop on the centre enough of the medium to surround and entirely to cover the lower side of the object. This may be done by a clean glass rod or tube drawn to a point: it may be kept closely wrapped in well-sized paper, and when in use should be protected from dust. The taking up and spreading of the medium on the slide may be facilitated by warmth from the spirit lamp: but of heat, no more should be applied than is necessary. The two things to avoid in this stage of the process are dirt and air-bubbles, both of which may be drawn away by a cold mounting needle: while air-bubbles may also be got rid of by almost touching them with a hot mounting needle, aided by warming the slip over the spirit lamp, which will cause them to come to the surface, to run together, and often to break. Next take the object which it is intended to mount, and place it on the centre, having cut it into shape and removed tags, if necessary, with the knife that cuts on glass. It ought to have on it no superfluous turpentine, benzole, or whatever may have been employed, as this protracts the hardening of the slide, tends to cause running in, and is apt to produce cracks as the slide ages. It may be lifted with a pair of forceps, a mounting needle, a camel's hair pencil (if small it is apt to be lost among the hairs), or the blade or flat end of a dissecting knife on and off which it may be floated. If delicate, take care that it does not project over the edge, as a section may thus be broken by its own weight. The stickiness of the balsam will retain it if it is made to touch by holding downward the side of the knife, &c., on which it is. Draw it on the blade with a camel's hair pencil; mount with the concave side upwards, if it has one, to avoid a bubble beneath: liquefy the balsam by heat, and work the object down with a mounting needle to the bottom of the drop, so that it rests on the slip. It will then be less likely to move with the covering glass, or, if it is foreseen that it will move, place it towards the side of the slip on which it is intended that the cover shall touch first. Examine it through the microscope with an inch or so objective, with the stage horizontally, lest it should run, and see if it is all right. Work out air bubbles, dirt, and threads, and then warm the slide for some time, so as to evaporate part of the essential oil in the balsam, thus making the object less likely to move with the cover. If much warmed, the object must be covered by the balsam, which may be effected by passing over it the glass mounting rod with the remnant of the drop of balsam attached to it; for if no balsam were on it, the turpentine, or other bridging fluid between the spirit and the balsam, would evaporate and leave it parched. Or, if there is any place which is free from dust, it may be allowed to remain there in the cold, when the balsam will consolidate more gradually.

Next, take a second drop of Canada balsam, dammar, or whatever else is being employed. This, by the way, is all that is required for crystals which will be already on the slide where they have been formed by evaporation. They ought, of course, to be in the centre of the slip, like other things, and it is preferable that they should not extend from edge to edge of the cover. Not only is it well to leave a clear space along which the balsam may adhere firmly to the glass, but damp may otherwise penetrate and spoil the crystallisation. But some crystals, and especially organic crystals, dissolve in resinous media, or at least, in the volatile substances which they contain, or which are used with them. With copper salts, for instance, this is evidenced not only by the crystals becoming worm-eaten, but by the whole slide turning blue. If this happens (1), use as little of the medium as possible, or (2) as little of its volatile part—*e.g.*, employ Canada balsam instead of Canada balsam and chloroform, and be careful about heat, as this favours solution; (3) previously saturate the medium, e.g., leave some Canada balsam in the bottom of a covered test tube, in contact with sulphate of copper, and let it dissolve as much as it can, with the aid of heat; or (4) use another medium. Pure cold-drawn castor oil, for instance, has been recommended, and, by Dr. Beale, his favourite liquid, glycerine; but he is speaking of crystals from animal sources. Another reason for not using too much heat with crystals is that they may lift from the slip, and so be spoilt; but the use of gum tends to prevent this. Canada balsam, moreover, and other highly refractive bodies, increase the transparency of objects mounted in them, and may thus finally render them almost invisible; so that from this cause they may *seem* to dissolve. Another way of mounting, then, is mounting in air, which needs no special description. All that is there needful is to use a cell, and to fix the covering glass with gold size in the way which will be directed for wet mounting.

Finally, having transferred the medium from the rod to the slip, allow it to spread till the object, e.g., the crystals, are entirely covered. This will be facilitated by heat, and by lifting the slip. If the medium is allowed to spread slowly, there will be less risk of air-bubbles. Then, taking a covering glass, warm it over the lamp, having made sure that there is no dust or thread on the side next the object: apply it as centrally and horizontally as possible, or let it touch first where the medium is highest, which should be at the centre. Carefully work it down with the mounting needles, touching it on the side toward which the object moves, so as to keep the latter in the centre. Work out air-bubbles if you can (they tend to *rise*), apply a spring clip, clear away gently superfluous medium with a knife, and put the mount away in a warm place. **F. G.**

"HOW TO MAKE A CHEAP LATHE."

[22044.]—It is a pity to spoil an otherwise satisfactory piece of work by a single weak point. To fit the bed on the top of the standards by a vertical screw is not to secure it efficiently; such screw will have no hold in the upright, which it enters in the direction of the fibres. Better far to cut the ends of the bed with short stump tenons, and mortise them to fit between the pair of standards, securing them with bed-screws and nuts. The holes for these screws should be large enough to allow a little play, and if the mortises are quite true at equal distances apart, the bed will stand truly parallel, and the bed-screws will brace the frame well together. No ordinary screw will hold if inserted into wood *with the grain*.

O. J. L.

FITTING CHUCKS TO HOLTZAPFFEL'S MANDREL NOSE, OF WHICH THE PITCH IS 9·43.

[22045.]—In 1881 Mr. Holtzapffel made me a pair of chasers, styled by him No. 3 screw tools. With them I have fitted several chucks, but to do so takes much time and labour, and I have been anxious to be able to make a set of taps by which castings might be fitted by simply boring them out to the proper size and tapping them with a wrench and three taps in succession. If I recollect aright, he told me that he chased the internal thread of chucks on a screw-cutting lathe with a leading screw of four threads to the inch, and finished them up with these chasers, using wheels 40 and 95, which will give a pitch of 9·45, leaving the chasers to alter them to 9·433. I have been thinking over the matter that you can cut them nearly exact on the screw-cutting lathe by getting a single extra wheel of 41 teeth.

Forty on mandrel drives 115 on stud, which causes 50 as a driving wheel to gear with 41 on the screw, thus $\frac{40 - 115}{50 - 41}$ 4 pitch of screw, proved thus—Drivers 40 × 50 = 2,000 ÷ 4 = 500; drivers 115 × 41 = 4,715 ÷ 500.

$$\begin{array}{l}500)4715(9{\cdot}43\\4500\\\hline 2150\\2000\\\hline 1500\\1500\end{array}$$

Most of the 5in. lathes have their wheels of 12 pitch, and Lloyd has not a 41 wheel in his list. If he had one no doubt he would sell plenty of them, as most people who had a lathe with a leading screw of 4 pitch would be pleased to be able to fit chucks to Holtzapffel's lathes if only for their friends.

There is a way of doing this by using 2 wheels 14 pitch by having one or two small wheels to use as idle wheels. If these numbers did not gear, it could be managed cheaply without having a special 41 wheel made: use, of 12 pitch, 40 to gear with 115, also of 12 pitch; let it carry as a driver a 50 of 14 pitch to drive 41 of same pitch on screw. If they do not gear exactly, they might be made to do so by one or two idle wheels.* Lloyd, of Birmingham, has wheels of 15 to 24 teeth at 4d. each, 50 at 8d., 41 at 7d.

If he only had his wheels of 14 pitch made in malleable cast iron, they might be used with 5in. lathes, and as he has every number from 15 to 101, except 68, 76, 78, 86, 88, 96, 98, and above that from 110 to 150, and a 180, the range of pitches at one's disposal would be vastly increased.

;Gereb Admi.

THE ELECTRIC ELEMENTS.

[22046.]—Mr. Sutcliffe (letter 22027) accuses me of "altogether ignoring the argument about zero." I must say I see very little argument in his remarks on this point in letter 21981.

Mr. Sutcliffe appears to conclude that if electricity be considered to consist of two distinct elements, we are unable to consider it as being a form of energy. I do not share this opinion. This simply means that I do not consider electricity to be the same form of energy as heat, light, &c., but that it belongs to a different category. Possibly this idea will be new to Mr. Sutcliffe. It is easy to say that the opposite states of positive and negative electricity simply correspond to the phenomena of heat and cold, but I think no one will really hold that there is anything in the phenomena of heat and cold at all comparable to those of the two opposite elements in the case of electricity. **Voltameter.**

[22047.]—It is strange that, in utter defiance of the opening words of the excellent Montaigne extract at the head of the Correspondence, letter 22027, p. 221, should have found its way into these pages. Does Mr. Sutcliffe really believe that the late Professor Maxwell, "a very giant of electricity," and one who enjoyed the reputation of being second to none in carefulness and accuracy, made a mistake for which any candidate in the advanced stage at South Kensington would stand a fair chance of getting plucked?

It would take up too much valuable space to point out all the errors amassed in the letter referred to, and it would be to the average reader quite unnecessary. We will observe a few.

Electricity measured as a physical quantity is, most certainly, *not* a form of energy, but only one of its factors. The energy of an electrified body is measured, not by the electrification, but by the product of the electricity and the potential, both being measured in the terms of a chosen unit. Sufficient electricity is evolved from a Daniell cell in a few minutes for all the effects of a violent thunderstorm; but the other factor of the energy, the potential, is insignificant, and hence the energy itself.

Again it may interest Mr. Sutcliffe to know that the fact that "*Maxwell failed to perceive*"—viz., that electric phenomena are due to a stress of the intervening dielectric, and not to a deposit of electricity upon the surface of the conductors, is a theory, which, if it does not owe its very existence to Maxwell himself, owes more to him than to any man else, and was his special study for the greater part of his life!

Again, in the case of electricity in motion, all the phenomena that show anything about the state of the dielectric, point to a rotary and not to a vibratory motion of the ether particles within it. As regards the theory of the voltaic cell, several physicists, whose names Mr. Sutcliffe will find in any biography of eminent men, have worked at it. Faraday spent some years at it, and, although his results are truly grand, and his works must for ever remain as a monument of thought and ingenuity, he made simply nothing out of those ultimate actions of atom on atom, of the mysterious connection that exists between electricity and matter. Helmholtz, Clausius, Kohlrausch, and others have experimented and theorised with like result. Finally, Mr. Sutcliffe has tried it and found "a perfect explanation." Will he not give us an article upon the subject? He may well rest assured that if he succeeds he will earn a name among the greatest scientific men of the day, to say nothing of gold medals from certain learned societies which may be turned to some sterling value.

Nabla.

DYNAMIC AND STATIC ELECTRICITY — ERRATUM — MESMERISM AND PHRENOLOGY.

[22048.]—I perceive that in my article, p. 208, I have stated the capacity of cable as 3·5 microfarads per mile; it should be 3·5 miles per microfarad. The calculations, however, agree with the correct figure.

In reference to the remarks of "F. R. A. S." (22012, p. 217), I doubt if the anatomists named have really *proved* anything about the local functions of the brain in mental actions: in fact, the subject seems beyond the reach of anatomical evidence. I have no great confidence in the details of phrenological doctrines: but the evidence of universal experience bears out the great leading divisions of mental, moral, and animal correspondence to the form of the head,—from the "forehead villanous low" of Shakespeare to the statues of the old Greek divinities, we find that the artistic observers of man have recognised these typical indications. But what I want to do at present is to indicate that the "doubt" "F. R. A. S." expresses is not well founded. The expression and acts of the subject when the mesmerist touches the organs, real or supposed, most probably have no relation at all to the organs themselves, but are the direct result of the will and expectation of the mesmerist. They simply bring us back to the point at which we started. **Sigma.**

OPTICAL MATTERS.

[22049.]—Our friend "Bow" (letter 21909) has hit the mark very correctly, and "O. V." has little more to say. "Dispersive power" is a term having really no definite meaning. If we make the sum of the radial reciprocals proportional to the differences of each selected pair of colour lines, which pair ought we to choose? Should it be C and G, or D and F; or might not some values between or near to these give a more satisfactory result? If this be so, and I am strongly inclined to think that it is, by what means can we ascertain what values to pitch upon? Or it may even be asked, can we hope to get a wholly satisfactory result in this way at all. Dr. Hastings says we cannot. Let us hear what he says:—"A reconsideration of the whole subject gave rise to quite a different method of determining the most appropriate value for the dispersive ratio. By it the question of limiting extent of chromatic aberration was not considered at all, but only a condition as to the amount of light-energy sent very near the geometrical focal image of a distant point. This theory (*American Journal of Science*, Vol. XI., April, 1878), after having been once formulated, was so satisfactory that there was no doubt as to its success even before testing it."

Now, what English or American friend will abstract and send to you, Mr. Editor, this important contribution to the literature of the object-glass?

I must thank "Bow" for his kind offer to copy out Airy's papers. I do not, however, need them for my own use; but if he thinks they contain anything interesting to the general optical reader of this journal, I trust he will make an abstract the most important parts, especially relating to [illegible], I send them to these columns.

As regards my essay, I find I shall have to spin it out much longer than I had intended; but I am anxious to collect together whatever seems interesting and useful, whether it be new or old. I fear there is not much chance of my articles ever appearing in book form: such a work could only have a very limited interest.

Orderic Vital.

AMATEUR WIND-INSTRUMENT MAKING.—II.

[illegible]—The measurements of a B flat mouthpiece are as follows:—See Figs. 1 and 2. A to B, [illegible]cent.; B to C, 4·1cent.; C to E, 3·4cent.; total, excluding A to B = 7·5; width of gullet at E [illegible]mill.; at C 8mill.; diameter of bore K 15mill. Mouthpieces vary a little, according to the views held by makers; but generally, the body from B to E is 7 cent. for a C clarionet, and 7·5cent. for a B flat clarionet. Some makers bore both clarionets the same size; this, of course, is also a matter of opinion. We now come to the most difficult part of the mouthpiece—viz., the lay—that is the part from D to E which gives the reed room to vibrate; it measures on a C clarionet about [illegible]mill., and on a B flat, 22mill. The bed G is made truly level to a surface plate, which is usually a piece of plate glass about 2cent. broad by [illegible]cent. long. We then form the part from D to E into a part of a circle, whose radius is about [illegible], the aperture being closed at D, and open about [illegible] mill. at E. This is effected by having slips of metal of known thickness to insert between the glass plate and the mouthpiece, cutting the latter carefully [illegible] amount of space is [illegible] that both sides of the wood are [illegible] and leaving the gauges [illegible] distance, so that they can [illegible] exact places. This [illegible] the usual rule- [illegible] employed among makers [illegible] keep a record of all the apertures [illegible] good ones, also an [illegible] mouthpiece bed, [illegible] measurements, the curve [illegible] It has not yet been [illegible] part of a circle, or [illegible] happens that a [illegible] considerably from any [illegible] a very care- [illegible] not give satisfac- [illegible] reed, [illegible] I now [illegible] measured by [illegible] the differ- [illegible] mouthpieces are [illegible]

[illegible]

without a squeak in a moderately quick passage. A set of measures or gauges for adjusting and altering mouthpieces are not easily obtained without expense and trouble, so I have carefully measured the thickness of paper used in printing the English Mechanic: it is four thousandths of an inch; thin foreign writing paper is two thousandths of an inch; and the plate in *Harper's Monthly* is seven thousands of an inch. Now, by using a number of these together, approximate sizes may be got if they are carefully cut and gently used. The inclination of the palate F, Fig. 1, has an influence on the pitch and freedom of the reed, especially in the higher notes of the instrument: a very concave palate making the high notes flatter and difficult to produce. The bore K should be the same size as the clarinet body: but sometimes it is desirable to have a mouthpiece that will flatten the instrument, and this is managed by having it narrower in the bore, and increasing the distance between B and C, the greatest amount practicable being about one-sixth of a tone lower than the tuned pitch. The breadth of reed for a B flat clarionet is 14·2mill. The C instrument has usually one a little narrower—say, 13·5mill. The body consists of a truly cylindrical straight tube, its office being to regulate the vibrations of the reed. By the opening of each hole in the side, a different length of tube is thus attached to the reed; consequently, more or less freedom is allowed to it: the column of air being longer or shorter, the rate of vibration is correspondingly less or more, and different notes are the result. A piece of cocus-wood is chosen and split up to 1⅜in. square by 17in. long for a C clarionet (the B flat requires about 19½in. long): this insures evenness of grain, which facilitates straight boring. The wood, after being rounded up in the lathe or dressed by a plane, is bored out thus. A Morse twist drill, of ⅜in. diameter and 5in. long, is fixed to the lathe mandrel by a socket; the wood being centred is screwed up against this drill by the back centre, and the boring proceeded with, the wood being gently turned the reverse way by hand, and the drill cleaned about every half-inch. When it has bored as far as it can go, it is then removed from socket and attached to a [illegible]in. round iron or steel shank, about 18in. long. The boring is then gone on with as before till it comes out through the end. Observe the following points, or an uneven hole, out of truth, is the result. Do not force the back centre up too tightly; clean the drill often; use a quick speed for lathe; and apply a little blacklead to the drill if it does not clear itself easily. The tube is then widened out by a scallop bit, well sharpened and adjusted with care to a little less than the size required, mounted on a long shank, same as above drill, and run in the lathe, the wood being held by both hands. As the bore is still a shade small, a sheet or two of very fine glasspaper, being heated gently to soften it, is rolled round a rod of metal, ⅜in. diameter and about 2ft. long, covering it about 8in., and brought up to the size of the bore, which it fits moderately tight; by pushing this slowly up and down a good surface is obtained, and the bore is equalised. When this rod becomes slack, unroll the sandpaper and insert a small slip of common paper, this will make it again fit the tube. The glasspaper is attached by resin to the metal rod, and wound tightly on. The bore now being up to size and parallel, a cork is fitted to each end, it is then filled with linseed oil, and both corks, which are extra long, forced in and kept under pressure by a joiner's cramp. It will be necessary to take out the corks and add a few drops of oil every day for a week or so, till the wood has taken up as much as it can. Sometimes it is best, however, to turn down the outside to its proper size before saturating with oil; and this is best done by fitting a plug of brass in one end for the back centre, the body being driven in the lathe by a turned-up pin of wood, projecting from the face-plate or chuck, accurately fitting the bore.

Vulcanite.

BICYCLE CONSTRUCTION.

[illegible]—I am much pleased to note that a correspondent has undertaken to instruct us on the art of bicycle construction, and I hope that [illegible] will come forward and do the same for the tricycle, which has now become such a popular favourite.

A Reader Since 1870.

CABINET-MAKING.—VI.

[illegible]—We will now set about making our [illegible], and we will start with our ends, the same as we did with the cabinet. Dress and square them up to 3ft. by 11in., running a ½in. check along the back inside edge to take the back; then serve the top and bottom the same, sizing them to 3ft. 3in. by [illegible]in. Dovetail them together the same as you did your drawer. Clean and sandpaper the insides, glue and drive together, and see that it is square. Prepare and nail in the back; make a moulding to go round the bottom, as shown in Fig. 1, letting it project ⅜in. over the ends and 1⅜in. over the front. Nail or screw it on to the bottom. Then we shall want a rack to support the shelves. To make this, cut a piece of pine 3ft. by 3in. by ⅝in., and make it like Fig. 2; then by cutting it into four you will have a piece to plant along each corner of your ends. They will then have the appearance of Fig. 3; and by making short pieces to fit between the racks you can have your shelves movable, so that you can shift them to the size of your books. You will want a cornice: you can make one to suit your own taste, or the same as Fig. 4, which is a section. To make it, you must cut two pieces 3ft. 4in. by 1½in. by ⅞in., and two more 11⅞in. by 1½in. by ⅞in., finished, dovetail them together, letting the ends into the front and the back into the ends. Glue and drive together, clean off front and ends, and cut a piece ⅞in. stuff 5ft. 6in. by 2in., round one edge, and then plant it along the bottom edge of the frame you have just finished, mitring it at the corners. Then cut a piece 6ft. 3in. by 4½in. by ⅞in. finished, make a mould of a piece of this wood the same as the moulded part of section, place it on the ends, and with your marking awl transfer the shape to the ends of the prepared piece. Run gauge marks along the face so as to keep the members straight, then with planes as near the shape as you have them run out the members to the shape and depth. To mitre the moulding you must make a box large enough to take the moulding when it is set on the angle of the bottom edge, then with a good tenon saw cut it, and if the box is well made you will have very little trouble in securing a close joint. Next cut notches along the back, as shown in section, and screw the front on, first fitting the two end pieces. Afterwards you can start with your doors. Proceed the same as with the cabinet, only the outside stiles should be about 1in. wider than the inside ones, mortice and tenon them together, then clean them off, fit them in their place, and they should just cover the front of the case at both sides and be about ⅛in. clear along the top and bottom: then dress ⅜in. of the edge of inside stile of right-hand door, cut a rod 2ft. 11in. by 1¼in. by ⅜in. finished size, run your gauge along the front edge set at ⅜, round it over down to the gauge marks; then check it the same as Fig. 5. Fix it on the edge of the right-hand door, and then hinge to the ends with 2½in. edge butts. Then make some beads to plant on the doors, the same as you made for the cabinet, and

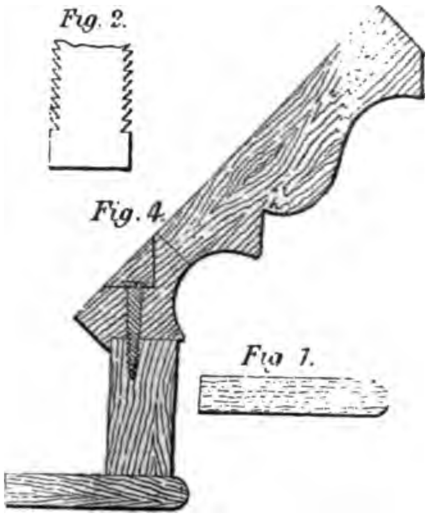


Fig. 2.
Fig. 4.
Fig. 1.

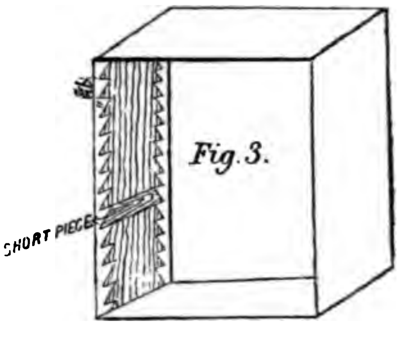


Fig. 3.

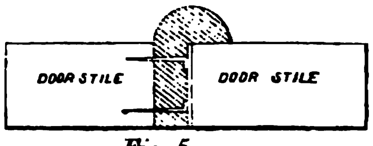


Fig. 5.

plant them in their place, allowing them to project about ¼in. to form a check to receive the glass.

You must now go over the whole job, and see that it is properly finished; then place the bookcase on the top of the cabinet, putting one 1¼in. screw in at each corner to keep it in its place. Fix the cornice in its place the same way, and the job is finished. J. P.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51577.]—**Rushton's Self-Acting Fountain.**—I take the following description of the above fountain from "Amateur Work." The figure

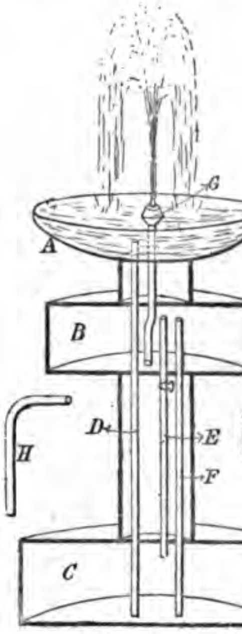
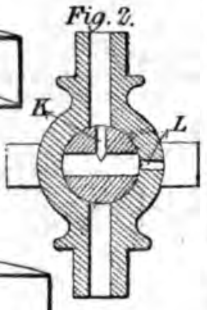


Fig. 1.

Fig. 2.



shows a basin A, and two cisterns B and C; to start, the fountain water is poured into basin and runs through pipe D filling cistern C, and leaving basin half full. The tap in pipe E is then turned, shutting off the only escape for the air, leaving only the way in through pipe D, and the way out through pipe F. Now take the small bent tube H placing one end in pipe D in basin, and blow for half a minute; this will drive the water out of cistern C, through pipe F, into cistern B. While the water is pouring into cistern B the air is escaping through pipe E by the tap, which acts as a vent as well as a shut-off from the cistern. Cistern C is now empty and cistern B full, and the fountain ready for playing off. Turn the tap, the water will then pass from the basin through pipe D into cistern C, drawing the air through E, and, pressing on the water in B, drives it through the jet G. When done playing, turn off the tap, place the bent tube on pipe D and blow as before; turn the tap and the fountain will recommence. This fountain is sold for 15s. 6d. It appears to me that the above description is incomplete; and that unless the cock is made with a small hole in its side as shown in Fig. 2, it would not act as stated.—Glatton.

[51619.]—**Specific Gravity.**—The constant 38·5 is found from actual experiment as follows:—Dissolve 1lb. of any simple substance in distilled water, and make the bulk up to 1 gallon by the further addition of water, then take the sp. gr.; the excess of gravity over water will be the constant required. If "J. R." is accustomed to laboratory work, he will get the same result by dissolving 10grm. of the substance in distilled water and making the bulk up to 100cc. by the further addition of water; the excess of gravity over water of the solution thus prepared, will give him the constants for the substance under examination.—N. C. R.

[51698.]—**Yeast.**—Mr. E. T. Scott, in his recipe, omits to say the quantity of water in which the ¼oz. of hops are to be boiled, but tells us that there is to be 1lb. of potatoes, rubbed fine (query, are they to be previously boiled?); we are to add ¼lb. of flour made into a paste with cold water and than usual (query, how warm?). I shall be glad if Mr. Scott will favour us with more definite instructions. It is with much surprise that I see hops so often mentioned in the manufacture of yeast. I cannot think they can have any effect, except to render it bitter, which is the very thing to be avoided. True they are used in the manufacture of beer—not, I imagine, to make it ferment, but to flavour it.—S. M. C.

[51865.]—**Scientific Library.**—Through pressure of work I have been unable to offer any remark on the above subject until now, but trust my experience may still prove of service. It was suggested by a correspondent that to purchase was a better plan than to subscribe to a library. Now, I think the following will perhaps cause a change of opinion. In the first place, it is taken for granted that every one wishes to see the latest edition of a work, and it is disappointing to find a new edition of a book appear when one happens to have bought a copy perhaps only a few months previously. In short, it does not seem to be generally known by "our" readers that this is a most excellent scientific library to which anyone may subscribe, the chief advantages of which are—1. All the works in the library are the latest editions. 2. The volumes can be retained by the subscribers any length of time, during the whole term of subscription if desired. 3. Books can be changed as one likes. 4. An unlimited supply of all the new and best standard works are added to the library as soon as published. 5. An extensive and classified catalogue is presented to subscribers. I need not add more, as the prospectus of the library will give any further information. I write in the interest of students and others, like myself, who have found my subscription to Lewis's Scientific Library, Gower-street, W.C., of immense value.—Preceptor.

[51880.]—**Pressure on Screw Propeller.**—I send a suggestion to find the pressure of a screw, on the basis that the pressure on an inclined plane will equal the amount intercepted at 90° at the same rate, but with a thrust of ·707, ·89, ·95, and ·97 of that of the screw for 45°, 22½°, 15°, and 11¼° respectively, and which will give a pressure of ·5, 1·6, 2·7, and 3·76 for each angle. Let the blades of screw in the case mentioned have a length of 4ft. and a turn of one in four at the rim: it will have an angle of 15° nearly at the centre of pressure. Then work per sq. ft. per sec. = (225 × 550) / 40 = 3093·75. Now to get the required pressure when moving, the screw would have to be turned ·414 faster. $\therefore 2{\cdot}7\ v\ (v^2 \times 62{\cdot}5) / (64 \times 1{\cdot}414) = 3093{\cdot}75$ $v = 11{\cdot}8$; and pressure per square inch = (3093·75) / (11·8 × 144) = 1·82lb.—J. Mead.

[51886.]—**Wimshurst Influence Machine.**—If the querist will but look through the last two volumes, he will find an answer to all his questions. On p. 426, Vol. XXXVI., there is an illustrated description. Twelve sectors will do, and they can be fastened to the glass with any of the usual cements, or with isinglass dissolved in acetic acid. The plates may be varnished with any hard varnish, such as shellac dissolved in methylated alcohol. The plates are fastened to the bosses with marine glue, or the common electrical cement. A metal spindle must be covered with ebonite, or some other good insulator. The other questions are fully answered in the article referred to, or in replies since.—Nemo.

[51890.]—**Tubular Pneumatic Action.**—This is simply the usual bellows connected to the windchest by pipes (gas tubing). Thus suppose it is wanted to add a rank of bourdons, they would be placed on a soundboard and be connected by tubes to the windchest instead of trackers to the keys. Wind being admitted by the pallet in windchest passes to the small bellows which opens the pallet of the bourdon. The latter is, of course, supplied with separate wind.—Organon.

[51893.]—**Simple Planing Machine.**—"Lumber" should look up his back volumes. He will find many illustrations of lathe-planers which he will be able to utilise.—Nun. Dor.

[51894.]—**Model Marine Compound Engine.**—The querist who asks whether it is possible for a compound engine to work without an intermediate receiver, the cranks being at right angles, should make a sketch with the positions of the pistons and valves accurately set off. That would open his eyes to see the difficulty of doing what he wants, especially in a model.—Nun. Dor.

[51914.]—**Feed-Pump.**—Make the feed-pump one-third the diameter of the cylinder, and its stroke one-half.—Nun. Dor.

[51917.]—**Battery for Bell.**—No doubt it is a manganese cell, and extremely doubtful whether "the cell is a zinc one," as you say.—Nun. Dor.

[51923.]—**Damp Cellar Vaults.**—I suppose it is possible to dig round outside and fill in with Portland cement concrete; or what is perhaps better, asphalte made of sand and boiled tar and pitch.—Junior.

a rule cheaper than they can be made; but "No. 23" can use logwood and sulphate of iron for black, and the aniline colours for red and green.—Manufacturer.

[51928.]—**Spectroscope.**—This querist should, I suppose, get Mr. Rand Capron's pamphlet (Browning), or read what has been said in recent volumes. See the index of Vol. XXXVI., and that of the last volume.—Nun. Dor.

[51931.]—**Lathe.**—This query has, I suppose, been answered by this time in the articles on "How To Make a Cheap Lathe": but if the querist has any peculiarities, surely he could ascertain the best height by marking it on the wall, standing as he would do in treading a lathe.—Essar.

[51944.]—**Coppered Wire.**—R. A. R. Bennett accuses "A Practical Chemist" and myself of being hard upon S. Austel; but, speaking for myself, I cannot see where the harshness comes in. My wish was to prevent any chance of the querist asking his chemist for copperas, and not to show up S. Austel in any way—although I do think that one should know the difference between sulphate of copper and copperas before sending a reply to such a query. Had the error been allowed to remain without correction, the querist might have ordered copperas, and, of course, would afterwards find that in place of a deposit of copper his iron wire would gradually disappear. With regard to the reply given by "Chemicus" on page 320 last volume, I may say that I never saw it—a fact which Mr. Bennett did not trouble himself about. The additional information given by B. is rather out. How would a pint of concentrated vitriol mixed with the same quantity of a solution of bluestone answer? Does B. think that the copper would continue to deposit itself after the wire has become coated with a film? If so, why use electricity in electro-metallurgy?—Ressorp, F.C.S.

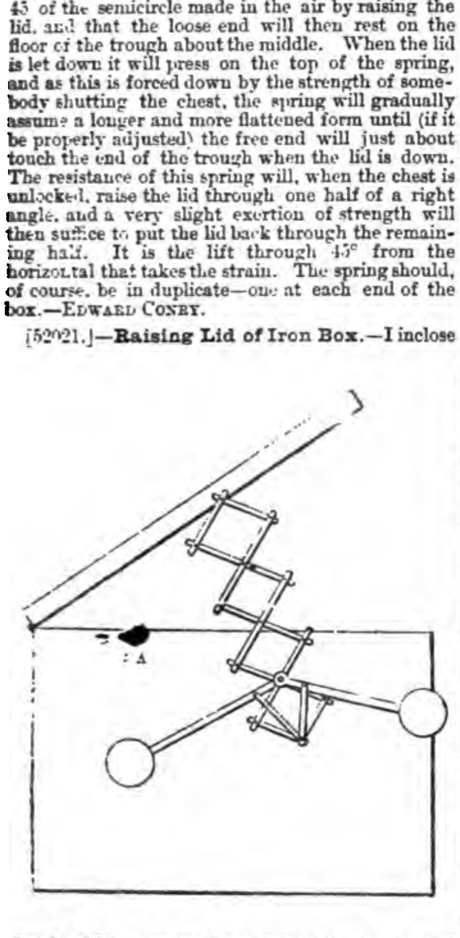
[51951.]—**Astronomical.**—By the inequality in the longitude of Mars produced by the Earth, amounting to 5 minutes in two centuries, is intended, if I am not mistaken, the motion of Mars's perihelion, produced by the action of the Earth, which thus affects the equation of the centre. A movement of 7″ per annum in 200 years will amount to 25 minutes, which, when Mars is in its perihelion or aphelion, will produce an effect of about 5 minutes in heliocentric longitude, with a plus or minus sign, as will be easily seen when we remember that the maximum equation of the centre of Mars is about 12°. Of course, the earth's perihelion is moved by Mars.—W. C. E.

[51961.]—**Cleaning O.G.'s**—I am with "Achromatic" obliged to "F.R.A.S." for the reply to query addressed to Mr. Lancaster and "Prismatique." It is best to clean as little as possible, yet damp should be removed, or the surfaces will stain in time. It is, I think, a good plan to put the telescope out with the cover on until all is at one temperature, or if it is used in an observatory, open the shutter some little time before uncovering the o.g.—this as a preventive. The spots are the result of damp which has evaporated and left residual pellicles behind it. As this is generally on the anterior surface, a little breathing on and careful wiping with a soft well-beaten washleather will remove them without taking the o.g. out of the cell. There is an increase of light produced by cementing o.g.'s; it is, however, necessary that the surfaces are perfectly in contact. This condition must be, or "Achromatic's" o.g. will not give good results cemented. I have used castor-oil and glycerine, the former with effect for some purposes; mixtures of oils have been used by an eminent optician for cementing large o.g.'s. I believe there is a tendency to slip down of the layer of oils—a sort of glacier is produced between the lenses, which makes the definition variable. Castor oil will, however, last a long time for a small o.g.; eventually it oozes out and makes a greasy mess of it.—Prismatique.

[51974.]—**Engine.**—To "Glatton."—I find that the diagram I spoke of, though all right in theory, does not give such accurate results as the ordinary elliptical diagram given by Rankine, without great nicety of drawing. I shall not, therefore, publish it unless asked to do so. As you do not give length of eccentric and connecting rods, I cannot give the *exact* point at which compression begins; but it is at about 1¼in. from end of stroke. Exhaust opens when piston has moved nearly 36in., and steam is cut off at 32in. If the Editor wishes it, I will describe the elliptical diagram, but, as it is so common, it seems scarcely worth the space. I do not know a simple rule. The plan of having both steam-ports open to exhaust at once is very bad.—Glatton.

[52020.]—**Raising Lid of Iron Box.**—The following arrangement answers very well, and is inside the box, instead of being attached outside and to the wall. Make inside each end of the chest a very strong steel spring of the best materials and of strength proportionate to weight of lid, the shape being that of a semicircle extended at one end something like the letter S laid flat, and with the top bend cut off. Screw one end firmly to the front of the chest, inside the trough, in such a manner that when the lid is up the spring will project to about 45 of the semicircle made in the air by raising the lid, and that the loose end will then rest on the floor of the trough about the middle. When the lid is let down it will press on the top of the spring, and as this is forced down by the strength of somebody shutting the chest, the spring will gradually assume a longer and more flattened form until (if it be properly adjusted) the free end will just about touch the end of the trough when the lid is down. The resistance of this spring will, when the chest is unlocked, raise the lid through one half of a right angle, and a very slight exertion of strength will then suffice to put the lid back through the remaining half. It is the lift through 45° from the horizontal that takes the strain. The spring should, of course, be in duplicate—one at each end of the box.—Edward Conry.

[52021.]—**Raising Lid of Iron Box.**—I inclose



sketch which may perhaps prove of use. It will serve to give an idea.—William E. Dawson.

[5203[illegible].]—**Caledonian Engines.**—Your correspondent, Mr. Spencer, asks about new C. R. engines. At the present time the first one is not yet out. There are 21 six-coupled goods engines building, 15 at Messrs. Neilson's and 6 in the Co.'s shops at St. Rollox. Neilson and Co. have also on hand an order for ten express engines, almost the same as N.B.R. "Waverley" class. The boilers in both goods and passenger are the same. The C.R. goods and passenger engines have a larger heating surface and slightly smaller firegrate. Besides these there have been rebuilt five of the 417—4[illegible] class, which have cylinders 18in. by 24in. and 6ft. 2in. coupled wheels. In a former volume I gave details of these engines. The rebuilt engines (Nos. 420, 427, 429, 432, and another) have boilers of the "Waverley" type, and cabs of G. & S.W.R. style, and working pressure 150lb. per square inch. The splashers, which were, for the most part, open, have been altered to solid ones. These engines were set to run the limited mail, and other express trains between Carlisle and the North and vice versâ. As I once pointed out in the "E. M.," the "Limited" is allowed 62 minutes to cover the 49¾ miles between Carlisle and Beattock Summit, and must run the first 40 miles in 44 minutes in order to leave time to ascend Beattock incline. Now this forty miles is anything but level:—First you have the Gretna bank about 15 miles (with a slight break) rising 1 in 200, and between Netherclench and Beattock (11 miles) there are 9 miles varying from 1 in 165, 200, 206, 300, &c., and lastly, of course, comes Beattock incline. There are no steep falling grades going North except about two miles 1 in 200, and about 30 chains of a decline leaving Carlisle, of 1 in 80 and 1 in 100. The rebuilds proved utterly inadequate to the task allotted them. They could not cover the first 40 miles in less than 55 minutes, and in some cases as much as half an hour was lost between Carlisle and Carstairs. The result is 420 and Co. have been relegated to work more suited to their powers. Now, it has lately been proved that the 76 to 87 class (eight-footers) can run this train, even with a stop at Beattock for *a pilot.* One of their number, about two months *ago, took 14 carriages from Carlisle to Beattock in 43 minutes (one minute less than the Mail is allowed). Most of the carriages* weighed about 14 *This was with the tourist* express. Now as I have, perhaps, made this letter too long already, I will conclude by saying that from these facts the engine of 1883 would seem hardly to have improved on that of nearly 24 years ago.—Carstairs, Glasgow.

[52043.]—**Induction Coil.**—To A. V. Nicholls.—Have made up coil according to your instructions, using, however, silk-covered wire for primary, but cannot get more than $\frac{1}{16}$in. spark. I should be obliged if you will tell me where I may be wrong. Would it be better wound in two sections? Also what would be the greatest battery power it would stand?—L. W. Willis.

[52062.]—**End Bearing for High-Speed Spindles.**—I am unacquainted with the principles of spindle machinery: but I should think that polishing hard rounded end of spindle dead true, and a fine polished flat agate or other hard stone for the bearing would do. It would reduce friction a great deal more than steel working on steel, especially if fit be not perfect—a watchmaker's experience leads me to suppose so. As an idea to keep oil from bearing, if a screw be chased about an inch or more on the bottom of spindle close down to rounded end, by the motion of spindle revolving forward the thread unscrews, so the oil which surrounds it will have a tendency to be forced down on the bearing.—H. W. Salter.

[52087.]—**Pressure on Crank-pin.**—From some cause or other, I see I have multiplied the quantities in this query crosswise; it ought to have been high-pressure 268·8 × 62lb. ÷ 2 = 8332·8lb.; low-pressure 490·875 × 18lb. = 8835·75lb., or total weight on crank-pin = 17168·55lb.—Engineer, Dewsbury.

[52103.]—**Engine.**—"Young Engineman" is right when he divides the whole length of the stroke by the distance traversed by piston at point of cut-off to obtain the number of expansions in one cylinder; but he will see by the following that this is not absolutely correct, when applied to the compound engine. For instance, let us take your engine, and suppose the high-pressure cylinder is 100 sq. in. area; and if the stroke of the pistons are equal, the area of low-pressure cylinder will be 400 sq. in.; and taking the stroke at 40in., the high-pressure piston will have traversed 20in. when the cut-off occurs; and here we have 100 × 20 = 2,000 cubic inches of steam, with an absolute pressure of 75lb. Here its volume is only *one*; but when it has passed into the low-pressure cylinder its volume will be eight times what it is now: for 400 × 40 = 1,600 cubic inches. I think this will suffice to show "Young Engineman" that he has obtained eight expansions, and not six, as he supposes. As such an interest is taken in compound engines, I will, with the Editor's permission, send a short article, showing the loss as compared with a single-cylinder engine with the same number of expansions. I see that, in answering this query, "Firer, Dewsbury," asks me how far the low-pressure piston will have traversed while the high-pressure piston remains stationary, to increase the volume twice? I will only say that the cubic capacities govern the volumes, from which he can calculate the distance at his own leisure. And I hope I shall not offend "Firer, Dewsbury," when I again say that his method of obtaining the number of expansions is not correct. For instance, suppose, from some cause or other (such as leakages), the back pressure was 9lb. (= 6lb. vacuum) instead of 2lb.; then the final effective pressure would be 9⅜ − 9 = ⅜lb.; then, by following out the method given by "Firer, Dewsbury," we shall have 56¼lb. ÷ ⅜lb. = 150 expansions, and yet the cut-off pressure, and all other particulars, except the resisting pressure, have remained the same.—Engineer, Dewsbury.

[52118.]—**Tarring Posts.**—The fence would last longer without the application of gas tar, if there were any sap in it, for if the tar were applied before the sap was dry the sap would gradually rot the wood away. If, on the contrary, the wood had been kept in a timber yard (or any other place where it might dry) for twelve months or so, the gas tar, under those conditions, would act as a preservative.—Rowen Valentine.

[52125.]—**Harmonium.**—If your instrument is an ordinary 2½ set harmonium, and contains one 16ft., one 8ft. and ½ set of 8ft., your soundboard will be divided into five registers, and for this you will require five apertures in valve board. The following dimensions for these will, I think, be suitable: Bourdon, 16ft. register, 6in. long by 2in. wide. Cor Anglais register, 5in. long by 1⅞in. wide. Flute register, 4 in. long by 1⅝in. wide. Clarionet register, 4½in. long by 1⅞in. wide. Celeste register, same as Flute.—G. Fryer.

[52127.]—**Platinum Crucibles.**—Metallic lead or salts of lead should not be melted in platinum crucibles, as it forms an alloy and destroys the crucible very quickly. Caustic potash or soda also injures it. Sulphur or sulphides also injure platinum.—William E. Dawson.

[52127.]—**Platinum Crucible.**—Compounds of the easily reduced and fusible metals, as tin, antimony, lead, bismuth, &c.; substances containing sulphur, as metallic sulphides; caustic alkalis, aqua regia, and many other substances are all more or less injurious to a platinum crucible.—W. Farquhar.

[52139.]—**Bearings.**—If "C." would apply some of Richards' plastic metal to his bearings, no doubt it would suit. The patentees are J. Richards and Co., Whitton-lane, Hill-top, West Bromwich, who supply full printed directions for using along with each ingot.—Whitewall.

[52143.]—**Chemical.**—In my reply which you printed last week, the third line from the bottom, which appears as "$\therefore x +$ [illegible] x [illegible] 32," should be "$\therefore x =$ [illegible] $x + 32$."—Spencer Collyns.

[52148.]—**Testing Lightning Conductors.**—The way to get over the difficulty is to make two temporary earths, which can be done by driving iron bars into the soil well moistened, and a few feet apart. Test the two first together, then test the lightning conductor earth against each of these separately. Tests should be taken with current reversed in all cases, to compensate for any polarisation effects due to difference in the several earths.—Sigma.

[52155.]—**Bicarbonate of Soda.**—Bicarbonate is manufactured by the action of carbonic acid on soda crystals, in iron chambers holding from a few tons up to 60. The CO_2 is obtained from chalk, or limestone, and hydrochloric acid, in covered tanks constructed of flags. The tank is partially filled with chalk, &c., and the acid run in by a pipe reaching nearly to the bottom, the gas escapes at the top. The chambers are best made of iron, as the heat is radiated away quickly; they are connected so that the gas enters the oldest chamber first, and leaves at the last-charged one. At the bottom of the chamber there are channels for running off the water set free during the reaction, and letting the gas in so that it passes through the whole of the crystals and leaves at the top. The inferior yellow crystals may be used, as the water set free carries off all impurities, consisting of sulphate and chloride, and colouring matter. The liquor runs off by a V-shaped pipe, preventing the escape of gas, and by the stoppage of the running it is known that the process is nearly finished; also tested by pushing a bar of iron into the chamber: when the bar meets with no lumps the process is finished. The bicarbonate has then to be dried, as it is very damp. This is done on shelves in rooms heated by hot air. The drying lasts about eight days. The dried bicarb. is ground in mills similar to corn mills, and sifted through a sieve with 20 holes to the linear inch. The mills must not get hot or CO_2 will escape, which will reduce the strength. It even loses strength by keeping for some time in the warehouse.—S. A. W.

[52160.]—**Battery.**—In reply to R. A. R. Bennett, p. 227, I have no idea how long any battery will last in action. It all depends on dimensions and work. I know no reason why a zinc and carbon battery should not keep in action for months, merely working a clock, if a sufficient supply of weak acid were available. A good Daniell of the Meidinger type, that is, supplied from a flask containing crystals of copper sulphate, on bird-fountain plan, will keep up such work for a couple of years. Mr. Bennett's plan is the worst he could use for his purpose. The salt should be at top, where it will dissolve and sink; when at the bottom of the cell it dissolves too slowly if a large current is wanted. It requires about five Walker cells to give the force of two Daniells, if in full work.—Sigma.

[52165.]—**Slide-Rule Formulæ.**—The formula given by "Glatton" may be put in this form—

s = speed of piston
d = diam. in inches
x = cub. ft. per minute

$$x = \frac{s \times d^2}{183}$$

or, 183 : s : : d^2 : x a proportion solved on the slide rule as given by "Glatton." It may also be solved with the inverted line I.

$$\begin{array}{llr} \text{A} & 183 & 29{\cdot}4 \\ \hline \text{I} & x = 11{\cdot}3 \text{ cub. ft.} = 70{\cdot}7 \text{ gallons.} & \\ & s = 130 & \\ \hline \text{D} & d = 4 & \end{array}$$

giving the result either in cubic feet or in gallons.—A. D. L.

[52165.]—**Slide-Rule Formulæ.**—As for calculations by slide rule, the figures and divisions on slides and fixed lines of instrument serve for mechanically obtaining, by additions and subtractions, what in the ordinary way of calculations require multiplications, divisions, squares, or square roots, &c.; so the formulæ for both systems are constructed from similar data and reasonings. Thus—To find the diameter of a pump for discharging a given number of cubic feet per minute, when the bucket lift is given in lineal feet, reckoning without loss, or deficiency in working. Here, 1st.—A cylinder 1in. diam., 1ft. deep, containing ·7854 × 12 = 9·424 cub. in., and a cub. ft. 1728cub. in.; then 1728 ÷ 9·4248 gives the contents of 183·346 cylinders 1in. diam. 1ft. deep = the content of 1 cub. ft.; or, 183·346 circular in. area = the area of 1 sq. ft. 2ndly. Cub. ft. discharge per minute ÷ lineal ft. bucket lift per minute, giving the content in cub. ft. of 1ft. length of pump; and 3rdly. Cub. ft. in 1ft. length of pump × 183·346 giving the area of pump in circular inches. Then, lastly: The square root of circular inches area = inches diam. of pump, 60. For simplicity, cancelling the decimals ·346 in 183·346, and using 183 for the constant or gauge point in finding the diam. of pump, to discharge, say, 285 cub. ft. per minute, reckoning the bucket lift 125 lineal ft. per minute, and no loss; from the preceding we obtain the arithmetical formula:

$$\sqrt{(285 \div 125) \times 183)} = 20{\cdot}42 \text{ diam. of pump}$$

60 Slide rule formula

Set 125 on slide $\frac{B}{C}$ opposite 285 on line A; and

Opp. 183 G.Pt. on do. $\frac{B}{C}$ is the circular inches area of pump on A = 417; and the inches diam. of pump nearly 20½ on square root line D—all at one setting; and supposing a Routledge or Soho class of slide-rule used, literally. The difference between the length representing 285 on line A and 125 on slide $\frac{B}{C}$, plus the length for constant, or G.Pt. 183 on $\frac{B}{C}$, giving the answer on D opposite the last sum in A.—BUTTERSHAW.

[52166.]—**Engine Power.**—The best thing that "C. C., Bradford," can do is to get some friend to indicate his engine; then he will get to know the power of his engine correctly. But we will suppose the engine to be a condensing one, with an initial gross pressure of 65lb. (of course that is allowing nothing for friction in steampipes, thoroughfares, clearance, &c.), and a back pressure of, say, 3lb. The theoretical h.p. will be 143·139 area of cylinder by 192ft. per minute by 52lb. average pressure (when cut off at half-stroke) ÷ 33,000 = 43·3h.p. When steam is cut off ⅜th of stroke, the h.p. will be 143·139 × 192 × 45·2 ÷ 33,000 = 37·6. When cut off at ⅝th of stroke, the h.p. will be 143·193 × 192 × 56·7 ÷ 33,000 = 47·2. When steam is cut off altogether I cannot see any power at all. Of course, if the engine be a non-condensing one, there will want 12lb. more deducting from the average pressure for the atmospheric resistance.—FIRER, Dewsbury.

[52166.]—**Engine Power.**—The following formula will solve such questions:—

$$\text{h.p} = \frac{A\,p\,n\,a \left\{ 1 + \log. \frac{l}{a} \right\}}{33000}$$

A = area of piston in square inches.
p = initial pressure of steam.
n = number of strokes per minute.
a = space described by the piston before the steam is cut off, in feet.
l = length of stroke, in feet.

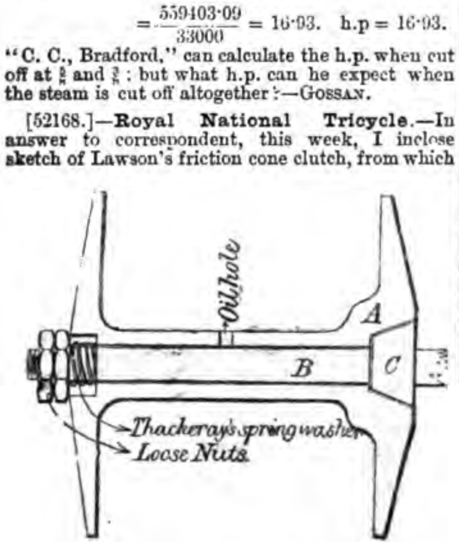
For the first case the h.p. will be—

$$\frac{141{\cdot}13 \times 50 \times 72 \times {\cdot}65 \left\{ 1 + \text{hyp. log. } \frac{1{\cdot}3}{{\cdot}65} \right\}}{33000}$$

$$= \frac{559403{\cdot}09}{33000} = 16{\cdot}93. \quad \text{h.p} = 16{\cdot}93.$$

"C. C., Bradford," can calculate the h.p. when cut off at ⅝ and ⅜; but what h.p. can he expect when the steam is cut off altogether?—GOSSAN.

[52168.]—**Royal National Tricycle.**—In answer to correspondent, this week, I inclose sketch of Lawson's friction cone clutch, from which he can see at a glance how it acts. Directly the steering handle is used to cause a divergence from the straight line, the tendency of the wheels to describe circles of different diameters causes the cone to be slackened in the hub of the loose wheel, and allows the shaft, with the cone which is fastened to it, to revolve in the hub. It is not really a double driver, except in a straight line, as during a turn to either side, one wheel, namely the one with the cone in it, runs loose. The whole affair is so very simple and so old-fashioned, that any lad can make it, and it cannot possibly get out of order, and needs no thought on the rider's part to look after it. I regret being such a poor hand at an explanation.—SECUNDUS HAUD ULLI.



A, section of loose hub; B, shaft of tricycle; C, cone fast on shaft.

[52167.]—**Good Time.**—Have a black board hung outside the time office, studded with nails, say three inches apart, equalling in number the maximum number of men employed. Get a corresponding number of brass or cardboard discs about 1½in. in diameter, and number them consecutively 1, 2, 3, &c. Have a box, like a child's money box enlarged, to receive the "checks." Each man, knowing his distinctive number, will take off his "check" and drop it into the box as he passes into the works. When all have gone in, the timekeeper empties the box, enters each man in his book, and hangs the "checks" up again in readiness for the next bell ringing. This is cheap and effective. —J. H.

[52171.]—**Legal.**—The Bank is entitled to stop the income tax. The daughter should pay her father the balance due to him, less the income tax on the balance, and pay her own share of the income tax herself.—J. R. PRIDHAM.

[52178.]—**Combustion without Flame.**—If you have a gas forge you can perform the same thing. Everybody who uses these finds out the same thing accidentally. I know we did in a shop I worked at nearly twenty years ago, and Mr. Fletcher is no exception.—JACOB MAGLOSKIE.

[52178.]—**Combustion without Flame.**—"Glatton" can easily repeat the experiment with a common sponge lamp. Take a piece of thin platinum wire about ·01 thick, coil it into a spiral a trifle smaller than the lamp tube. Light the lamp, and turn it down till only a small part of the white flame shows. Then hold the spiral in the flame a little above the wick, and when glowing blow out the lamp. The wire will continue to glow. A few trials will soon show the best size of flame and height the spiral is to be held. The result depends upon the power platinum has of condensing gases upon its surface, and bringing about their union—in this case, the spirit vapour and oxygen of the air; in Mr. Fletcher's experiment, gas and oxygen. The vapour of ether can also be made to unite with the oxygen, by pouring a few drops of ether into a tall ale glass, attaching the spiral to a card, making the spiral red hot, and then immersing in the glass. Some years ago, Prof. Dobereiner, of Jena, invented a lamp in which a stream of hydrogen was made to impinge upon a ball of spongy platinum. The union of gases was so rapid as to make the metal white hot and inflame the gas. It is said that gold and palladium possess a similar property. I have not tried these; but the first-named experiment has been a common one with me. I give it, as many may like to try the experiment where gas is not comeatable.—R. P.

[52178.]—**Combustion without Flame.**—The experiment referred to by your correspondent is one of many which collectively prove without question that flame is not only unnecessary for combustion, but its existence is a proof of sluggish combustion, low temperatures, and a low available fuel duty. It is possible to burn any fuel perfectly without flame with proper appliances. The experiment referred to was one devised to show clearly on a lecture table the possibility of burning a fuel extremely liable to make black smoke, without any flame or visible sign of combustion further than the intense heat, and also to show the difference in temperature produced by the same fuel with and without flame. The appliances necessary are a bundle of fire iron wire waste, say 3lb. to 6lb., a large blowpipe, and a good blower. Hold the blowpipe a few inches away from the ball of wire and direct the strongest possible flame which can be obtained with the blowpipe and blower on to the bundle of wire. When fully hot, pinch the gas supply pipe for an instant so as to extinguish the flame and let the unburnt mixture of air and gas be driven against the white hot wire. The heat suddenly rises, and in two or three seconds the wrought-iron wire fuses and runs into drops and, except this intense heat, not a trace of any signs of combustion can be seen. I have produced the same result with lumps of red-hot firebrick, both alone and mixed with coal slack. The latter appears to "evaporate," becoming converted directly into heat without the intervention of a trace of flame. This flameless combustion is utilised in my injector furnace, in the body of which no trace of flame can be seen when it is hot, and its practical application in many ways is possibly only a question of time. One application of it as an auxiliary to melting furnaces for coke, will be treated in a paper I have now in preparation for a lecture on the use of gas as a labour-saving agent in mechanical trades, a report of which no doubt will be published in the "E.M." before the end of the year.—THOS. FLETCHER, Warrington.

[52183.]—**Legal Settlement of Real Estate on Wife.**—If you settle the property on your wife and you were afterwards to get into debt, as you suggest, your creditors could not come on to her for satisfaction of their claim if you were free from debt at the time when you made the settlement. You say you were free from debt at the time, so I should advise you to do as you suggest—give it to trustees without power of sale, and they to pay her the rents, &c.—J. R. PRIDHAM.

[52188.]—**Lubricating Oil for Lathes.**—The neat's-foot oil, treated in the way mentioned by "Cressington," with a few bits of lime, and exposure to the light, will certainly be a very excellent lubricant; but anyone who wants a really good lubricant, should get hold of a good sample of neat's-foot oil, place it in a clear glass bottle, and shred into it a number of clean lead shavings. Then hang that in the sun for weeks, or until it is wanted. The lime acts more quickly in removing any free acid; but the action of the light, combined with that of the lead, produces the very best lubricating oil that can be obtained. Sperm may be served in the same way.—NUN. DOR.

[52189.]—**Transparent Varnishes for Glass.**—Add any desired pigment of the transparent class to the best white paper varnish, commonly called map varnish.—NUN. DOR.

[52190.]—**Copper Extraction by the Wet Process.**—If "A Norwegian" will refer to p. 362, No. 302, he will find a longish article on this subject. On p. 267, No. 298, he will also find an account of the process patented by Prof. T. Sterry Hunt and J. Douglas.—NUN. DOR.

[52191.]—**Equal Increments of Temperature.**—The expansion of liquids is very irregular, varying with the liquid and the temperature. A few liquids like mercury expand regularly within certain limits. The expansion does not depend on the specific gravity. You will find a good deal of information on this subject in Pictet's "Eléments de Physique."—PLUTO.

[52192.]—**Musical Examinations.**—This querist will get all the information he wants by writing to the hon. sec. of College of Organists, Great Russell-street, Bloomsbury, for prospectus, which gives a list of books recommended for study. —WM. A. TAYLOR, Dundalk.

[52193.]—**Telescopic.**—I think most of the statements made in my paper, read before the Liverpool Astronomical Society, are supported by the actual experience of observers. Possibly, though, a little further explanation may render my meaning clearer. With regard to magnifying power and aperture of telescope, I ventured to express some dissent from the usual ideas about 100 to the inch. It may do for moderate apertures, but breaks down utterly when applied to extreme cases, like many other empirical formulæ. Who would dream of using 100 diameters with 1in. o.g., perfect though it might be, on a double star? Theoretically it should be possible, but practically it would fail from want of light. Again, would the Washington 26in. o.g. bear a power of 2,600 diameters, or Mr. Common's 37in. speculum a power of 3,700 on stars? I believe not. The atmosphere is the great limit of magnification in telescopes. With regard to Jupiter, Saturn, and Mars, I found that powers of 200 to 250 suited the first-named best, with 4in. o.g., 5in. o.g., and 11¼in. speculum. But, of course, far more *detail* is seen in the larger than in the smaller instrument, with the same power. Saturn, with me, will bear a higher power than Jupiter—I have sometimes used 500 on it with good effect with the 11¼in. The sketches of Mars alluded to were those made by Mr. Green at Madeira; and the others with the 26in. Washington o.g.—both at the same opposition of 1877. Mr. Green's telescope was a 13in. reflector, and nearly the same powers were used on each instrument. The results may be seen on comparing together the plates on p. 13, Vol. XL. R.A.S. "Monthly Notices"; and p. 138, Vol. XLIV. R.A.S. "Memoirs." *Why* certain powers should be best suited to certain objects, is beyond my power to explain—I only know it *is* so. As to the apparent contradiction between the views expressed in the above paper, and those contained in the "E. M." of Feb. 23, 1883, I entirely fail to see it. When I spoke of "a large reflector with as high a power as the atmosphere would bear," I alluded to those usually found in the hands of amateurs, of from 8in. to 15in. or so of aperture—not imagining that I should be understood to mean reflectors of 3ft. or 4ft. diameter; nor did I intend to convey the idea of 100 to the inch, or anything of the kind. Powers of 200—400 diameters would be most useful. In reference to single lenses, I have had little experience; but a friend of mine tells me he tried experiments with both convex and concave single lenses, on a first quality 2½in. o.g., some 15 years ago, and, though they did give a very little more light, they were much inferior to a good Huyghenian eyepiece, on the whole. I daresay it might be possible to get a view of Saturn's belts with the aperture and power mentioned, as Grover has seen them with 2in., but it requires an exceptionally keen eye. I would strongly recommend my querist to get a good Huy-

[52225.]—**Raising Steam by Gas.**—At a meeting of persons interested in gasmaking the other day, it was stated that unpurified gas for heating purposes could be made at a profit at 1½d. per thousand feet; this result had been arrived at by a series of experiments. I should like the opinion of the readers of this journal as to whether it is practicable or not to use such gas in the furnace of an ordinary two-flued Lancashire boiler in place of solid coal? Of course, an intensely hot flame would have to be produced by mixing the gas with air—blowpipe manner. It seems to me if this could be put into practice, we need not have our long chimneys here blackening everything with their smoke—and without any increase of expenditure. There are readers of this paper quite competent to take this matter in hand, and I should be much obliged if they would give their ideas on the subject.—Kunst Macht Gunst.

[52226.]—**Equatorial Motion.**—I thank Mr. Vallance for his description of equatorial motion, letter 21933. I intend adapting it to a 10in. Calver altazimuth reflector; may I therefore ask for a little further information, viz.—Is it necessary for the tube to be "carried on a wheel," if so, how is it fixed? And I cannot clearly define the position and working of the meridian string.—Lox.

[52227.]—**Vacuum Brakes—L. & N.W.R.**—Would some of your numerous correspondents be good enough to tell me whether the vacuum brake that has been fitted to the coaches of the above line is automatic or not, as the moment the driver creates a vacuum it stops the train without him opening the valve on the engine? Also, whether there are gauges in the guards' vans? And is it the same that is used on the L. & S.W.R.?—H. W. Hudson.

[52228.]—**Electro-Magnets.**—I wish to make an electro-magnet with soft iron wire as the core. The wire I have is known as fine tying wire, and is covered with a coating of plumbago. I wish to know whether I had better put it into the fire and heat it so as to burn the plumbago off and soften it still more if possible; and also what shape I should bind it up. Will it be better to keep it in a round bundle in section or rectangular? Also are bobbins absolutely necessary? If I cover the limbs with brown paper paraffined or shellacked, and wind the covered wire on that, will not the arrangement answer as well as bobbins? I hope no one will waste space by telling me that soft bar iron is the proper thing to use. I do not want to know that, but the best way of making an electro-magnet, with wires for the core. I shall be obliged for information on the points indicated.—S. R.

[52229.]—**Induction Coil.**—Will Mr. Lancaster, or someone, kindly advise me? I have to light three gas-jets with an induction coil. I have run the leads in cleats, the wires being a full inch apart, and yet I get sparks as if they were in dead contact. The coil has a condenser. Has this anything to do with it?—Young Electrician.

[52230.]—**Legal.**—To Mr. Wetherfield.—I have for years had my life insured for £1,000, and have by this time paid up the amount in premiums. Can I by deed of gift, or otherwise, so make it over to my wife that at my death she may have it free from all legacy and probate duties?—An Anxious Husband.

[52231.]—**Self-Closing Door.**—Will anyone send description of contrivance for closing a door? No weights.—Chemicus.

[52232.]—**Brass Polish in Liquid.**—Can any reader give me the recipe for a good brass polish in liquid—one that will give a brilliant polish without injuring the metal?—F. W.

[52233.]—**Boiler Feed from Cistern.**—Will any brother subscriber kindly enlighten me as to the head of water necessary for the feed-pipe of a boiler for steam supply to a large cooking apparatus? Valve set at 5lb., and boiler fed by ordinary lever valve and float stove.—Putloo.

[52234.]—**Electrical Measurements.**—Will some of your many talented readers oblige by working out a scheme of electrical measurements as applied to a dynamo, so that I, and I suppose some others, can follow the working? I know the meaning of volts, ampères, ohms, coulombs, and so on, but think I should get a better grasp of them if I had but one practical instance of their application as a guide. I hope this is not too much to ask.—A Private in Electricity.

[52235.]—**Manganese Battery.**—None of the books available to me state the strength of the salammoniac solution for the manganese cell. Should it be saturated? Mr. Sprague's book says about 2oz. to the cell, but does not state the size of the cell.—Herne Hill.

[52236.]—**Combining Weights of Tartaric Acid and Bicarbonate of Soda.**—Will any reader explain the method of calculating the combining weights of bicarbonate of soda and tartaric acid?—Cabino.

[52237.]—**Jointing Material to withstand the Action of Soap Lees.**—We have a little trouble with some of the joints of our newly-laid suction and delivery pipes from a set of pumps used for pumping lees in a soapworks. The lees consist of dissolved caustic lime and caustic soda, and caustic potash, which causes some of the joints to leak? The pipes are screwed wrought iron, properly put together (as for steam), the threads were filled in before being put together with a mixture of red and white lead, and small quantity of hemp gasket laid in threads. I should be obliged to any correspondent who would kindly tell me of a better jointing material to withstand the action of lees in joints of screwed piping. For joints in flange pipe we use indiarubber, which answers perfectly. We also have some trouble with a few joints in the steam-pipes (chiefly at the backnuts) where the pipes unavoidably have to dip, and water accumulates at times when the pipes are not in use. We use lees in steam boiler to prevent incrustation. Would that have anything to do with leakage in steam pipes?—C. J. R.

[52238.]—**Induction Coil.**—To Mr. Lancaster.—Will this, or some other experienced gentleman, kindly tell me where I have gone wrong? Core of No. 20, 9in. by ¾in.; primary, 2 layers of No. 16 s.c.; ebonite tube secondary, 2½lb. of No. 36 s.c., wound barrel-shape in two sections, each layer insulated with hot paraffin and paraffined paper; condenser, 82 sheets of foil, effective area of each 6¼in. by 8¾in., and paraffined paper. Attachments: One standard of reel commutator to screw of break, the other to primary, and the springs to battery terminals, the other end of primary to the hammer; condenser, one part to each of the two parts of the break. Using five round Bunsen cells with 7in carbons, I get (without the condenser) a good ¼in. spark;—with it, none whatever. Are the connections right? Is the condenser too small or too large?—X. U. C. L.

[52239.]—**H.P. of Engine.**—Will any reader tell me the h.p. of my engine with the following dimensions? Length of stroke 4in., diam. 2in., piston making about 50 strokes per minute; pressure of steam 10lb. as indicated by boiler gauge. There is about 1 16 lead, and the port is ¼in.—A. G. B. W.

[52240.]—**Stone-Polishing.**—Would some reader kindly describe the bench and tools used in the shops—especially as regards the velocity and fixing of the saw?—Lapis.

[52241.]—**Defective Ejector.**—To S. Austel, "Glatton," and "Labor Omnia Vincit": Many thanks for your replies to my last query about defective ejector—having got it to work all right now by putting into it a new cone a little longer than the one it had when I took it in hand, lifting the water immediately steam is turned on, I would also ask you kindly to work out the following? What is the bursting pressure of a railway wheel press, diameter of which is 7in. Thickness of metal (cast iron) 2in. I saw one give way recently having the above-mentioned dimensions, with only a pressure on of three tons per square inch, and by Molesworth's formulæ it ought not to have burst at anything like three tons pressure. It was broken up to see if iron was defective, but was found to be made of very good iron. Now please explain, also, what is the pressure that engine wheels of 3ft. diameter are generally forced on axles by press, and where could I get a working drawing of one suitable for engine wheels from 2ft. to 3ft. diam.?—Hombre.

[52242.]—**Legal—Deferred Agreement for Lease.**—A. takes a farm for 12 months, with a stamped agreement for a seven years' lease at the end of the 12 months. B. refuses to grant the lease, as he says A. has not fulfilled the terms of the original agreement—nearly three years having elapsed since A.'s entry on the farm, can he now take proceedings to get a seven years' lease from B.?—Alton.

[52243.]—**Lifeboat.**—When will there be a lifeboat exhibition? Is there a lifeboat in use with wheels and axles for horse or horses to draw to the water's edge or along the beach or shore instead of the common process of mounting it on a "lorry," and dismounting it to launch it? If so, where can I see it?—Grace Darling.

[52244.]—**Analytical Theories.**—Of late years physical theories have been presented in very abstract mathematical formulæ in such works as Murphy's "Electricity," Fourier's "Theory of Heat," &c. I would wish to know whether the fundamental application of mathematics in such works proceeds on demonstrable principles like those in dynamics (which I doubt can be possible), or whether it depends on empirical results—results obtained by taking a formula at random and finding by experiment that it holds good in a certain number of cases, and hence concluding that it holds good in all cases.—Synthesis.

[52245.]—**Lever Watch.**—After cleaning the works of a lever watch I am unable to put the chain on fusee and barrel properly. Full instructions how to proceed will greatly oblige. I can get the chain on in such a manner that it will only wind up half the length of the chain. I tried a second time and got it on so that I could wind it fully on the fusee, but it stopped when half the length of the chain was wound on barrel from fusee.—G. Fryer.

[52246.]—**Payne's Battery.**—With regard to letter No. 22028, p. 221, I shall be much obliged to Mr. Payne if he will give a description of the battery he alludes to, also the number of cells required to work a two-candle power incandescent lamp? I presume the new cell requires about the same attention as one of the ordinary Leclanchés.—Thos. J. Inkster.

[52247.]—**Photographic.**—(1) Can someone describe the process by which microscopic photographs are made? I do not mean photographs of microscopic objects, but photographs that are themselves microscopic. I have not seen a description of this anywhere, and do not understand how a film is made of sufficient fineness to show such detail. The development, too, must present great difficulties. (2) What is the theory of the action of the alum bath?—Calculus.

[52248.]—**Trustee—Retirement under a Will.**—Testator died 12 years ago, leaving widow and one son, and all his real and personal property in trust, widow to have the interest therefrom until son attained 21 years, son then to have a portion of the interest paid to him quarterly, and the remainder to widow, and after her decease the whole of the property to be the son's absolutely. Now the widow and son still live, and son above 21, and the trust all square up to now, and I, as one of two trustees, desire to retire, and have notified widow to that effect, who, according to will, may appoint another; but she refuses to release me unless the other trustee retires, and he won't. I have always been the acting trustee, and have had enough of it. Now can I by law enforce the widow to release me, and how shall I proceed, and at whose cost will it be? The son is of drunken propensities, and I want to get clear of him and the trust.—Trustee.

[52249.]—**Chromograph.**—Will any correspondent who has actual experience state the mode in which the paper sheets sometimes used in lieu of the dish of jelly are prepared, giving the proportion of ingredients and mode of manufacture? Also the most approved mode of making the jelly? Also a practical recipe for preparing the multiplex aniline ink for the chromograph? Recipes for this have been given in back numbers, but I have not found them answer. I have tried in vain aniline crystal powder, 1oz. by weight with 7oz. by measure of water, and one of methylated spirit, but the recipes did not specify the exact nature of the aniline to be used, whether it was to be powder or fluid, nor whether it was to be weighed or measured. One recipe for "copying aniline ink" recommends the addition of 1½oz. of glycerine to the pint of ink; but this appears to be for common copying ink, yielding one copy only—not the multiplex ink to be used with the chromograph.—S. M. C.

[52250.]—**41 Arietis.**—As a quadruple star I find this in Proctor's smaller atlas, and in Letts's maps, but not in Webb's last ed. of "Cel. Obj." as such. Can any one direct me to it in this book, or give me magnitudes, angles, and distances?—J. C. L.

[52251.]—**The Sun and its Markings.**—A friend of mine has a telescope with very good o.g. 1¾in. diam. He persists in stating that he can see with it the "rice grains" appearance on the sun. Is this possible?—J. C. L.

[52252.]—**Bunsen Burner.**—(1) What is the proper shape and size for the orifice of a Bunsen burner? (2) Any advantage to have it of platinum? (3) Can reducing and oxidating flames be produced, as with a blowpipe, and how?—Thor.

[52253.]—**Spectroscope.**—Names of a few books on analysis by means of the spectroscope would be esteemed. Also replies to the following:—(1) Are the "rainband" spectroscopes suitable for analytical purposes? (2) If not, can the latter be obtained in the convenient size of the former—i.e., a small tube 3 to 4in. long? And (3) where are they to be had?—Thor.

[52254.]—**Lantern.**—In Pepper's "Cyclopædic Science Simplified" is illustrated a lantern for showing opaque objects—photographs, hand, face, &c., by reflection. As the description given is not quite sufficient for the making a lantern, would any kind reader oblige with the information? Can a surface as large as a man's face be illuminated by an ordinary-sized condenser? Size of screen about 10ft.—H. L.

[52255.]—**Parian Cement.**—I should be greatly obliged if some of your correspondents would inform me what is added to the sulphate of lime to form the above? I believe the patent has terminated some time since.—Finch.

[52256.]—**Brush Dynamo Machine.**—Will "Light" and "W. H. E." accept my thanks? I have acted on the advice of the first mentioned (Oct. 26th), and have connected A coils up in the way he explained, and find my machine will work, but not as well as I expected. In the first place, I connected a small Brush lamp up with the machine: this only gave poor results. This lamp will give a light of 30 c.p. on another machine made by Oppermann Bros., so the lamp is not at fault. I disconnected this and joined all coils up to brushes and started machine without any shunt, and found the energy so strong that 1 h.p. would barely turn "A" in this way, then connected a 15 c.p. incandescence lamp up as a shunt, and it gave full light. On adding another on same wires, the light fell to only 5 c.p. for the two. How can I alter this? The old two pieces on commutator I've replaced by straight ones, as well as new brushes made from No. 16 brass wire? The speed of my machine is from 1,400 to 1,500 revolutions per minute. If I join my wires up on the Gramme principle, shall I get any better results? Will "Light" or "W. H. E." kindly advise me on the above?—Williams.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 14, and unacknowledged elsewhere:—

K. B. Williams.—O. B. Olsen.—H. King.—Jas. Roberts.—Edwin Norris.—Boro of Nottingham.—W. Goyen.—F. A. Moilliet.—A. H. Fison.—Capt. Lysaght.—Wynfett.—Prismatique.—A Fellow of the Royal Astronomical Society.—R. E. B.—Shakespeare.—S. R. Bottone.—York and Son.—An Amateur Tuner.—C. T.—Thos. Henry.—Weston.—Lymington.—X.—H. B.—F. C. F. Artisan.—P.—A. E. H.—Arthur Mee.—T C.—Charlie.—A. H. Booker.—Darkness.—Luir.—Credo.—E. H.

T. H. (You should consult a surgeon. Dr. Edmunds said all that can be usefully said in a general way on p. 194, No. 893.)—F. M. H. (The question has been frequently answered as well as it can be. It depends on the resistance of the lamps. Probably fifteen cells would be sufficient for the small lamp. 2. The Telephone Company would answer that question, and tell you the amount of the royalty they charge.)—O. M.

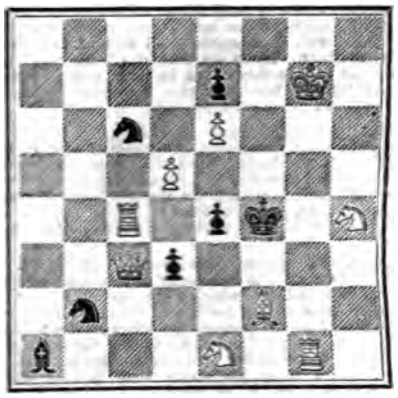
[illegible] has already promised it as soon as [illegible] You [illegible] information [illegible] as the remedy [illegible] for you to [illegible] assell and [illegible] work of the kind required. [illegible] series of small volumes on the [illegible])—CODADAD. (You will [illegible] in last week's number. Trace [illegible] you fail to find the information [illegible] we cannot help you.)—RATS. [illegible] been recommended: they [illegible] to that.)—PHENOL. (Must [illegible] replies and articles which have [illegible] volumes.—QUAESTOR. Dab putty [illegible] good as any- [illegible] magnesia or [illegible] sulphate of [illegible] solution of gum arabic, [illegible] be protected from weather [illegible] consult the [illegible] Mr. Fletcher, of Warrington. You [illegible] in back numbers—one so [illegible] number for Sept. 14.—J. G. T. [illegible] get them made, as you [illegible] can get the [illegible] Charterhouse- [illegible] to cover thin [illegible] you can buy [illegible] than you can make it, [illegible]—AMATEUR. (The stone has [illegible] If you want to go in for [illegible] Grammar of Lithography," [illegible] Wyman and Sons, Great Queen-street, [illegible] are wanted, you will find [illegible] in back volumes, or in cyclo- [illegible] You are bound to give six [illegible] at the time at which the [illegible] Unless your daughter [illegible] for the stage, it would be in every [illegible] something else. We can give no idea [illegible] her education and appren- [illegible] The letter was not lost—we [illegible] not space for it; but you [illegible] with it, which we did not [illegible] them with your present [illegible] try and find room soon, [illegible] do so sooner under [illegible] (Try red putty; [illegible]—ONE BEWILDERED. (Had better consult a solicitor; she must employ one to arrange the sale of the houses, and he will see about obtaining the deeds.)—E. K. Very difficult to reproduce pencil sketches. Besides, we have one of the planet as seen by "F.R.A.S." in preparation for next number. Best thanks all the same.)—VULCAN. (Either you have made some mistake in copying or the [illegible] are useless. See Nos 857, 880, or Nos. 881. [illegible]—J. GREEN. (In [illegible] want to make a telescope [illegible]

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLX.—By G. J. SLATER.

Black.



White. [9+7

White to play and mate in two moves.

SOLUTION TO 858.

White.	*Black.*
1. Kt to Q B 5	1. K-B 7 (a)
2. R-Kt 3	2. K-B 8
3. Kt-K 4	3. Mates
	(a) 1. P-K 7 (ch)
2. K-K sq	2. K K 6
3. R takes B	3. Kt mates

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 858 by Dicky Sam, R. A. Bennett; to 859 by J. B., of Boxford (some, very good mates), Rev. W. Anderson, Dicky Sam.

MR. C. HENRY JOHNS, 47, Marine-parade, Worthing, wishes to meet with a gentleman who would like to play a game with him by correspondence.

THE *British Chess Magazine* for November contains an interesting paper on the advantages and pleasure of playing over games that have been published between masters—especially to those who are unable to join a Chess Club or to meet an opponent over the board. There is also a list of 55 rare and valuable chess works on sale.

ENGLISH MECHANIC Tourney game between Mr. W. T. Pierce (*White*) and Mr. J. Russell (*Black*):—

Scotch Gambit.

1. P-K 4, P-K 4 / 2. Kt-K B 3, Kt-Q B 3 / 3. P-Q 4, P takes P / 4. Kt takes P, B-B 4 / 5. B-K 3, Q-B 3 / 6. P-Q B 3, K Kt-K 2 / 7. Q-Q 2, P-Q 3 / 8. P takes P (a), B takes Kt / 9. P takes B, K Kt takes P / 10. Kt-B 3, Kt takes Kt (b) / 11. P takes Kt, Q Kt 3 (c) / 12. B-K B 4 (d), Castles / 13. Castles (e), B-B 4 / 14. B-K 2, Q takes P (f) / 15. K R-Kt sq, Q-K 5 / 16. K-Kt 2 (g), Q-K 2 / 17. B-Q Kt 5, P-Q R 3 / 18. Q R-K sq, Q-Q 2 / 19. B-Q 3, B-Kt 3 / 20. P-K R 4, K R-K sq / 21. R takes R (ch), R takes R / 22. P-R 5 (h), B takes B / 23. Q takes B, P-B 3 / 24. Q-B 3, Kt-R 4 / 25. K R sq, Q-Kt 4 / 26. B-R 6, Kt-B 5 / 27. B-B sq, R K 2 / 28. Q-Kt 4, P-K B 4 / 29. Q-Kt 5, Q-Q 2 / 30. Q-Kt 2, R-K 5 / 31. P-B 3, R-K 3 / 32. Q-Kt 5 (i), R-K 7 / 33. P-R 3, P-R 3 / 34. Q-Kt 6 (k), Kt-K 6 / 35. B-Kt 2, Kt-B 7 (ch) / 36. K-Kt sq, Kt-K 8 / 37. Q takes R P (l), Kt-Q 6 / 38. B-B sq, Kt takes B / 39. Resigns (m).

NOTES BY MR. RUSSELL.

(a) In a recent number of the *British Chess Magazine*, Mr. W. T. Pierce recommended this move as superior to the usual continuation 8. Kt-Kt 5. In his able analysis, showing that this move results in a good game for White, there was one weak point—viz.: 8. $\frac{\text{P takes P}}{\text{B takes Kt}}$ 9. $\frac{\text{P takes Kt}}{\text{B takes B}}$ 10. $\frac{\text{Q takes B}}{\text{Q takes P}}$ 11. $\frac{\text{Kt-R 3}}{\text{Castles}}$, where Black has undoubtedly the better game. White's next move is a successful attempt to improve on this faulty variation.

(b) B-K 3, keeping White's Pawn isolated is perhaps better; but Black was afraid of the reply 11. Kt-K 4.

(c) Temporarily confining the White K B.

(d) A lost move, since White cannot capture the B P without subjecting himself to a powerful attack; a preferable continuation is 12. $\frac{\text{P-K B 4}}{\text{Castles}}$ 13. $\frac{\text{B-Q 3}}{\text{P-K B 4}}$ 14. $\frac{\text{Castles (K)}}{}$

(e) Injudicious, in view of the disposition of Pawns on his Queen's flank. Castling should be performed on K side as indicated in last note.

(f) A dangerous-looking move; but Black has no alternative, as otherwise White will play P-Kt 4 next move, followed by P-K R 4, and the phalanx of Pawns will bear down on K with deadly effect.

(g) A better line of play is 16. $\frac{\text{B-Q 3}}{\text{Q takes B}}$ 17. $\frac{\text{Q takes Q}}{\text{B takes Q}}$ 18. R takes B, followed by B-R 6 and Q R-Kt 3, and White has a good game.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 23, 1883.

HINTS ON CARPENTRY.—III.

CLOSE JOINTS.—Most, or rather all young hands experience the difficulty of making a close and accurate fit of the various parts of their handiwork. If it were easy to imitate skilled professionals in this respect, a tedious apprenticeship would not be required. But there is, in reality, no wrinkle—not even that suggested in a recent letter—that will prove satisfactory. The first requisite is an intensely sharp paring chisel, and a fine clean-cutting tenon saw; or, for very light work, the smallest mitring saw, which is generally made with a straight handle of boxwood, and not over 5in. or 6in. long. The teeth are fine, and barely set at all, and the cut made is almost as smooth as would be formed by a knife. These saws are just suited for picture-frames, and specially for Oxford frames. Another very handy saw is a fine fret saw set in a steel frame and called a piercing saw. I do not mean a fret-saw frame, which is much larger and heavier, but a small adjustable one such as are imported from Germany. They come into use for many small jobs, and are very inexpensive. Any fret-saw blades will fit them, and if they get broken they are easily replaced. Many will cut brass as well as wood, and answer capitally for nicking small screws. I have cut through a bit of mahogany an inch square and more without a break, and very quickly. The great difficulty is accurate sawing, and where it can be used there is no objection to "A.'s" plan of insuring a straight cut by making a groove with a knife; but there are many cases in which such a tool would be of little use—notably, in cutting dovetails, where the cuts do not go across the entire piece, but are disconnected.

I must, however demur to "A.'s" rounded tool edges. A hollow-ground tool is far easier to set on the hone, and is altogether superior to a convex-edged one. As to a guide to hold the tool during the grinding, no practical workmen use them; and it must be remembered that although the tool is to be held steadily at the given angle, it should be made to traverse from side to side across the stone, in order to prevent the latter from wearing hollow in the middle.

The lighter and smaller the job, the greater, as a rule, is the difficulty of accurately fitting the joints, because it is more difficult to square up the edges of a thin board than a thick one. You can apply a square to the latter and at once detect any roundness or convexity; but it is difficult to see it with a very thin bit of stuff. As a light job, a stamp box is a good one to work at. The olive-wood ones are beautifully neat, and the corners are jointed in a peculiar way, but a very strong one, allowing the outside angle to be neatly rounded. It is far superior in strength to a mitre joint. Looking down upon the edge of the open box, it will be seen to be like Fig. 6, A B; but the drawing is, of course, a much enlarged one. The ends are rebated like C, and the front and back grooved like D. In all boxes in which there is a deep cover similar to the box itself, it is as well to glue up the stuff wide enough for both box and cover, and then to mark it round with a gauge and saw it in two, thus separating the cover; the edges will need planing with a finely set and very sharp plane. There is more likelihood of making a good fit in this way than by making box and cover separately. There is still difficulty—and perhaps neat squaring of the edges is the worst of it; but careful paring with plane or chisel, supplemented, if needs must, by a file, will accomplish the task; and if sandpaper is used for a final touch, let it be wrapped round a flat chisel shank or bit of wood, so as to save the edges of the work from being rubbed off. They must be left as sharp and true as possible. Suppose it is required to make a box with similar joints, the first job is to clean up with utmost care, and with sharpest of planes, the bit of board of which it is to be made, and which may be ¼ stuff for a box not over 6in. long; and I may mention that as a rule it will be better to make the ends of an oblong box thicker than the sides, though this is not absolutely essential. In a very small box it is not necessary, and in a dovetailed one it cannot be done—i.e., if the joint is a *simple* dovetail, because it would appear as Fig. 7, A. But with such a joint as that last mentioned and illustrated there at B, or with a rebated dovetail, C, it can be managed satisfactorily. In the plain dovetail, A, of 45, a mitre block is used to shoot the edge; but the surface in small work may be also made true by a sharp chisel to gauge lines accurately scribed, as H of Fig. 8. The mitre shooting board is made like Fig. 8, A D; D is a piece of well-seasoned wood forming the bottom board; A a block with an accurately planed face at 45° to D, and firmly screwed to it; C is a stop block, B the board to be planed to a mitre at *e*. The plane is laid on its side on D. Attention must be called to *b c*, the small perpendicular face of the block A. This is necessary, because the plane iron does not quite reach the sides of the sole, and therefore would not cut the wood quite to the bottom of the face *e*, if the part *b c* were not so made as to lift the wood slightly off the base board D. The main difficulty here is, that the mitre has to be planed across the grain of the wood; and however well the plane is set, the edge of the wood next to the stop is sure to be torn slightly.

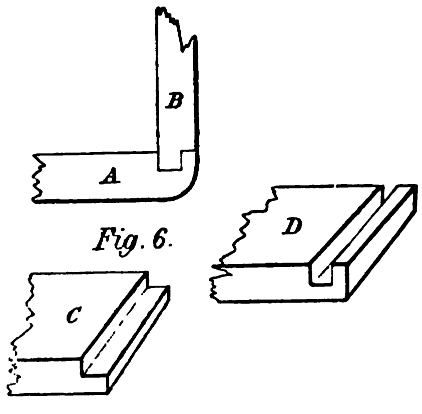


Fig. 6.

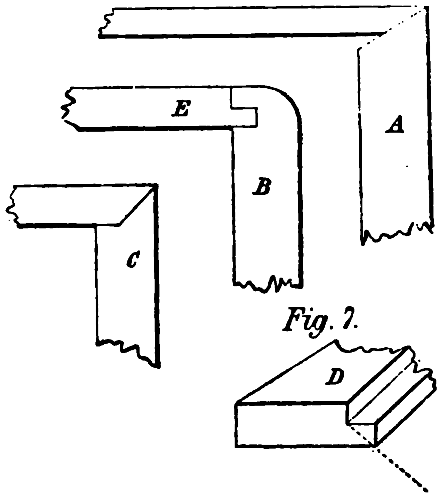


Fig. 7.

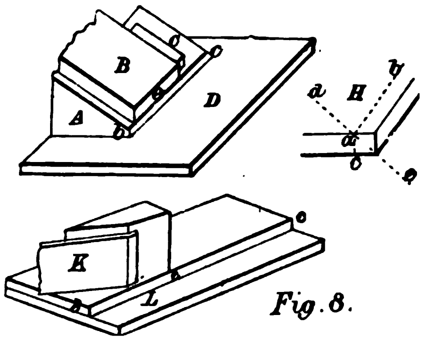


Fig. 8.

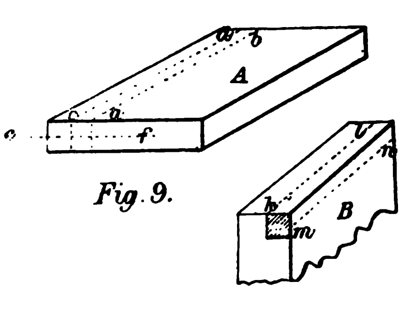


Fig. 9.

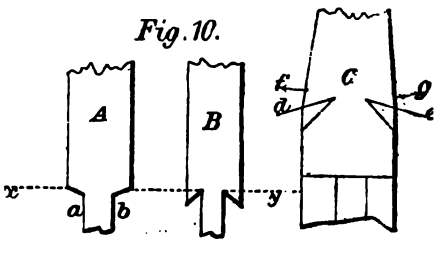


Fig. 10.

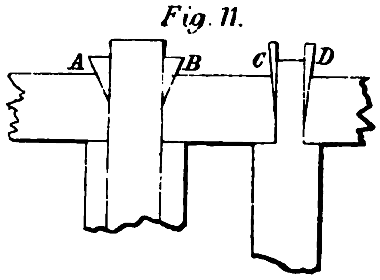


Fig. 11.

The remedy is to leave the wood wide enough to allow such torn part to be subsequently edged up true. But it is also possible to make the mitre board so that the plane will cut the way of the grain, as shown below; but in this case the width of the work is limited to that of the plane iron. This is shown at K L of the same figure, in which it is seen that the board to be planed stands on edge against its block. In this form, the face *b c* is formed by a separate board, screwed to the lower one. In both cases, this face serves not only to bring the entire surface to be planed into contact with the plane iron, but it also prevents the latter from damaging this face or that of the block, as the wood of the sole of the plane outside the corner of the iron rests against it. The wood to be cut is gently advanced after each shaving is taken. In H of this drawing I have shown how to gauge and saw, and finish with the paring chisel, any light piece of mitred work. The line *a b* is gauged at a distance from the edge of the board exactly equal to its thickness, and the piece is cut on the line *de*. This forms a perfectly accurate mitre, easy to make. To make such a joint as that shown at B of Fig. 7, set a marking gauge to the thickness

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meteorological conditions; but from a series of observations extending over three years, Miquel estimates the number of "germs" per cubic metre of air as 44 in winter (Dec.—Feb.), 76 in spring (March—May), 76 in summer (June—August), and 134 in autumn (Sept.—Nov.). Rain, he finds, cleanses the air; but humidity is an obstacle to the diffusion of bacteria, which is promoted by prolonged dry weather, with this result, however, that a very long continuance appears to rob the spores of their powers of reproduction in the liquids usually employed for their cultivation. The direction of the wind has some effect on the numbers of microbes found at Montsouris, N. and N.E. winds naturally increasing the numbers, as the observatory lies to the south of the city. As Paris is approached the number of germs increases enormously, until in the centre of the city the comparative figures are 462 as against 45 at the park of Montsouris, though it is noticeable that air taken at the height of the lantern on the Pantheon gives only 28. The same kind of increase is noted when dry dust such as falls on furniture is examined, for while one gramme yielded 750,000 at the observatory of Montsouris, a similar quantity in the outskirts of the city gave 1,300,000, and in the heart of Paris 2,100,000, the proportions of the different species varying at the same time. Thus in Paris more than two-thirds were micrococci, while at Montsouris more than two-thirds were bacilli. The vitality of the germs, gauged by their reproductive power, is greater in those found in deposited dust than in those which have been blown about by the wind; but although less numbers are found in the air of sewers, owing to the natural humidity of those places they are far more active, and consequently more noxious. Amongst the microbes found by Miquel in various specimens of air and dry dust obtained in different parts of Paris, it is curious to note that although the total number found in sewer air is less than in dwelling rooms, in the streets the percentage of bacteria is 26, as compared to a mean of 5 in nine other specimens, the air of the streets containing the largest percentage of micrococci, while that of the inhabited rooms contains about equal quantities of bacilli and micrococci. Not much is to be made out of that fact, though, for unless hard-and-fast lines are laid down, it is not always easy to separate bacteria or microbes into the groups above defined. In the park of Montsouris, 24,000 microbes were deposited on a square metre in 24 hours; but in the laboratory this number was multiplied by 100, which suggested to Dr. Miquel the advisability of ascertaining which was the most powerful antiseptic. He found that in peroxide of hydrogen, or oxygenated water, which, being obtained by the baryta process, was considered absolutely harmless. Five centigrammes of that, added to a litre of bouillon, stopped all fermentation promptly, as did 25 centigrammes of iodine, 60 of bromine, 320 of carbolic acid, 350 of permanganate of potash, 750 of boracic acid, and 1,000 of salicylate of soda. These quantities are rather too much to suggest that the last two substances might be used as preservatives for food, but if soup can be preserved by the addition of a little oxygenated water, a useful hint may be found in the discovery of the French *savant*.

The difficulties of making accurate estimates of the number of microbes in the air of different places are well known; but probably no better method of setting about the work could be devised than that adopted by Dr. Miquel. Strips of glass smeared with glycerine have been used by some experimenters; others have used the method of washing the air contained in a large bottle; but these, like the simple plan of exposing sterile putrescible fluids to the atmosphere, serve only to demonstrate the presence of germs, without conveying any adequate idea of their number. Dr. Miquel takes a piece of glass tube about 7in. or 8in. long, one end of which he seals hermetically, and closes the other with a plug of glass wool, which, like cotton wool, filters the air, it is believed, completely. In the centre of the length of this tube, however, he places another plug of the glass wool, and the whole being placed in a furnace, is subjected to a temperature of between 572° and 752° Fahr., sufficient, it is believed, to destroy every living germ. The tube is then placed horizontally some distance from the ground, and air forced into the tube through the middle plug, the hermetically closed end having been broken to make the connection. The air in passing through the plug of glass wool leaves the germs behind it, and the tube can then be resealed for examination at leisure. The middle plug, which contains the germs of the air it is desired to examine, is washed in sterilised water, and that is then put drop by drop into a number of flasks of sterilised nutritive fluid. If the liquids contained in these flasks (which should be protected from the external atmosphere) remain clear, it is tolerably certain that the air was free from germs; whereas if a number of them show signs of microscopic life, it is usual to allow one germ to each flask, and, the quantity of air being known, to estimate the number of microbes by a simple multiplication sum. Prof. Tyndall, it may be remembered, made a series of experiments on mountain air, and arrived at the conclusion that the atmosphere at high elevations is remarkably pure and free from germs, and the more recent experiments of Prof. Freudenreich support that view. The observations made by Prof. Giacosa, of Turin, on the Monte Murzo last year, however, would appear to indicate that bacteria are always present even in mountain air; but there is much reason to believe that in his case the test liquids were not properly sterilised, and showed signs of life simply because germs had obtained a lodgment in them before they were exposed. Be that as it may, the results of Prof. Freudenreich's observations on the air of the Swiss Alps confirm those already obtained by other experimenters, for as a general result specimens taken at heights of from 2,000 to 4,000 metres above sea level (say 6,600 to 13,000ft.) were found to be free from germs; at Lake Thun the proportion was found to be 0·85 per cubic metre, and at the town of Thun in free air 2·1, confined air 60. Prof. Freudenreich's samples were taken from the summit and the foot of the Eiger, on the top of the Schilthorn, and on the Strahlegg, all of which are more than 2,000 metres above the sea. Lake Thun is 560 metres, and the town 600 metres above sea level: hence it follows that the air over water is purer than that of towns at a higher elevation. Comparison experiments made at the observatory of Montsouris and in the Rue de Rivoli, Paris, give 760 and 5,500 microbes respectively to the cubic metre of air. A cubic metre is, however, a very small quantity of air, and it is obvious that before the question can be considered as definitely settled, a more extensive series of experiments, on a much larger scale, must be carried out. It is, however, already established beyond dispute that the air of towns and that which can be found in such apartments as the laboratory of the Montsouris observatory is, compared to that of even moderate elevations, heavily charged with microbes, the great majority of which are, happily for us, innocuous, and especially so when the wind can blow them about as it pleases. Hence, considering the number found in the dust of rooms, it is desirable to remove that without spreading it about, and also to provide for free ventilation.

PATTERN MAKING.—XVIII.

Sheave Wheels (*continued*).

A SHEAVE WHEEL recessed for alternate links of a chain can be made by pattern or core box. It requires almost as much care in pitching out as a spur wheel, because if there is a slight error in the pitch, that error increases with each successive link. Thus, when we commence to lay the chain in, suppose we find the recesses are $\frac{1}{16}$in. too far apart, the error will not remain at $\frac{1}{16}$in. all the way round the ring, but will be an $\frac{1}{8}$in. in the third recess, $\frac{3}{16}$in. in the fourth, $\frac{1}{4}$in. in the fifth, and so on, so that by the time we had got half-way round a large wheel no reasonable amount of clearance between the links and their recesses would prevent the chain from riding out of place. In pattern wheels we can always insure accuracy by roughing out the recesses to a slightly larger diameter than we deem necessary; and then, trying the chain in, gradually reduce the wheel until the chain fits neatly all round. But when a wheel is made with cores we have not this chance, and then we must take especial care in getting the exact pitch of the links first of all, and in transferring that pitch to the drawing from which the core box is to be made. Measure off the total length of a definite number of links, and divide that total length by the number of links measured; this average will be the pitch of the chain, which we forthwith transfer to our drawing-board. Working thus we shall not find our wheel at fault after it is cast. Some clearance is allowed sideways and endways for the links, say $\frac{1}{8}$in. all round, and the recesses are worked out of the solid with gouge and chisel, in pattern and core box alike.

In all other respects the directions we have given for the making of plain sheave wheels will apply to these as well.

A common rope wheel is similar to a plain sheave wheel, with the exception that its inner sides are inclined at a somewhat acute angle to bite the rope in the bottom of the groove. This object is sometimes also assisted by little semicircular bits, or nibs, pitched at regular intervals, and standing a little above the groove. Be the rope wheels large or small, the same methods of making the patterns will be adopted as in the previous examples.

But there is a modification of this form which is sometimes used, and which is somewhat puzzling at first sight—I mean the wave-wheel form. It is a rope wheel, in which the rim, instead of continuing in one circular plane, as in ordinary wheels, is bent or *waved* in serpentine fashion—the object being, of course, to increase the friction of the rope, and thus prevent it slipping.

This is a device which is seldom adopted in small wheels, and therefore it is so seldom necessary that a complete pattern should be made thus that we shall only consider it as applying to a wheel made entirely with cores. The remarks we previously made as to the method of procedure to be adopted in the preparation of the core-boxes will be applicable here until we arrive at the working out of the internal blocks. Then our difficulty will be to insure that the metal in the rim shall be of uniform thickness throughout. If we go working away at the curves at random, trusting only to the eye for accurate results, we shall probably find a variation of an eighth or a quarter-inch in the thicknesses of different portions of the castings.

So we work in the following way. Draw in elevation a segment of the wheel, equal in length to the intended cores, Fig. 96, A, B. Draw also lines on this view to the wheel centre, at the pitch distance of the wave—viz., at these points where it attains its greatest deviation from the plane of the wheel. Draw a portion of the rim with the width of the core box besides in plan, Fig. 97, and carry the lines representing the pitch across it. At these points draw sections of the rim in its extreme positions *relative to the sides of the boxes*, Fig. 98. Between these extreme deviations of the wave draw other lines at pleasure (not shown on engraving), projecting these to the plan and drawing corresponding sections, also in relation to the sides of the core boxes. Then making templets to the inside and the outside of the rim, all we have to do is to work narrow portions of the rim at the distances from the edge indicated in the sections, and to shape the intermediate portions with gouge and chisel as regularly as possible. If this is done care

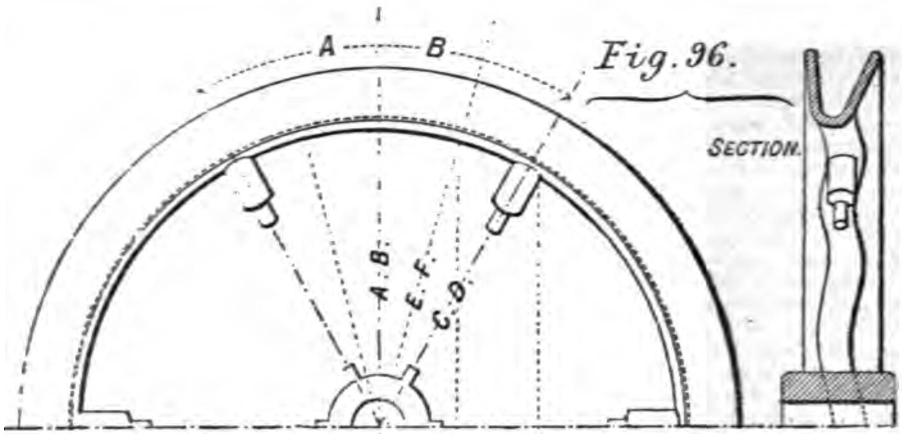


Fig. 96.

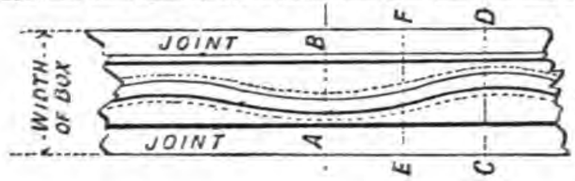


Fig. 97.

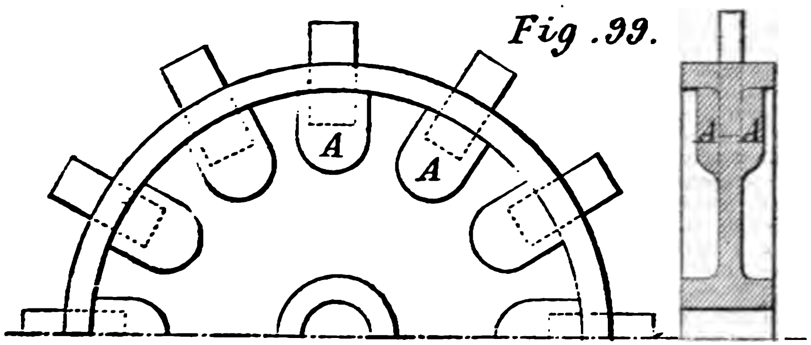


Fig. 99.

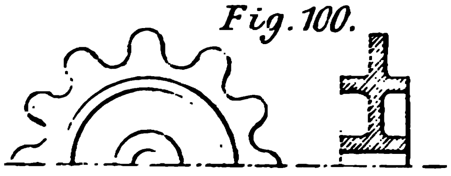


Fig. 100.

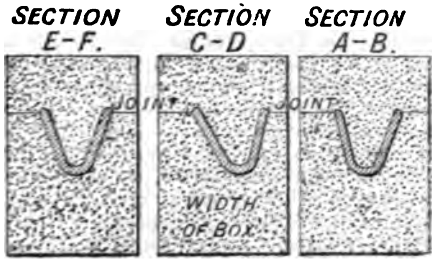


Fig. 98.

fully, there will be no appreciable difference in the thickness of the wheel rim when cast.

The last form of chain wheel we shall describe is that known as the *sprocket* wheel. It is a form which is in very general use for the transference of motive power by means of a "pitch chain," Fig. 99. Like the chain wheels, they require to be pitched out very carefully, else the pitch chain would ride on the projections, or "sprockets," instead of dropping over them.

These wheels are made in two forms, the first like the Fig. 99, where the sprockets are made of wrought iron and cast in the wheel body; the second like Fig. 100, in which the sprockets are a portion of the casting. In the former case they are dropped into prints, whose edges are their exact counterparts: in the latter the pattern and casting are precisely similar.

In these castings the links must fit the places prepared for their reception so nicely that it is sometimes necessary in a large wheel to throw away the first cast and make a slight alteration in the pattern, a variation in the anticipated amount of contraction being sufficient to cause an ⅛in. or ¼in. in the semicircumference. The wheel might be saved in such a case by filing a lot of clearance in the sprockets; but "fudged" work in not to be commended. The accuracy of a small casting can be depended on.

After what has been said about the building up of wheels, special remark is scarcely necessary in reference to these last named. Note, however, that a built-up plate made in two or three thicknesses or segments is better than a single *solid piece* of stuff, where the sprockets are cut *out, because stint (short) grain* and shrinkage are both avoided thereby. On this plate the two portions of the rim are built as usual.

The prints for wrought iron sprockets should be pocket prints, to be stopped over after the sprockets are placed in the mould.

Fig. 99, A A, are the boss thicknesses around the wrought iron sprockets.

THE DYNAMO: HOW MADE AND HOW USED.—VIII.*

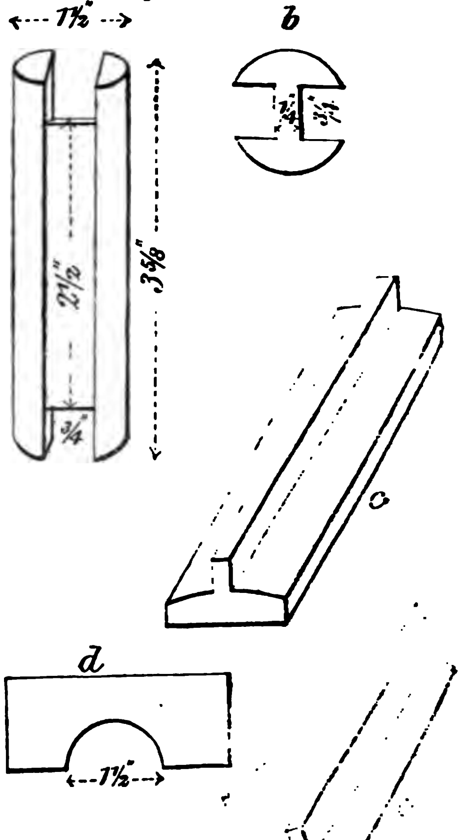
By Selimo R. Bottone.

The Patterns.

§ 18. IN the dynamo we are about to construct, three separate pieces for patterns are absolutely necessary—viz., one for the armature, one for the legs of the field magnets, and one for the standard which supports the flywheel. There is no necessity for the amateur to put himself to the trouble of cutting out a pattern for the flywheel, since such wheels with handles already fixed can be had for two or three shillings. In constructing the wooden patterns, from which the iron castings are afterwards to be procured, the amateur should remember to choose dry, well seasoned wood, free from knots. Red pine, for such small work as is required, will be found as good as any. Any joints that are absolutely necessary (and joints should be avoided as much as possible) should be attached together with dowels and Prout's elastic glue. It must be borne in mind that the pattern-moulder places the patterns in *green* (moist) sand, and that this moisture causes ordinary glued joints to come undone or expand. Any roughnesses left on the pattern also swell up, catch the sand, and thus destroy the sharpness and beauty of the mould, and therefore of the resulting casting. It is therefore advisable, after having got the wooden pattern to the highest possible degree of smoothness and trueness by means of emery paper, &c., to give it a coating of melted paraffin wax, and polish the surfaces carefully with a roll of flannel. This renders the surfaces not only extremely smooth but impervious to moisture, so that the pattern does not warp or swell when placed in the sand. In order that the pattern should come clean out of the sand and not break away any portion of the mould, care must be taken that the edges be slightly rounded, so as to give what is technically called *clearance*. The possessor of a *lathe* can turn up many portions of the fittings with much greater accuracy and rapidity than one provided with only ordinary tools: but in the ensuing directions the amateur is supposed to possess tools of the simplest kind only.

§ 19. The pattern for the *armature* first demands our attention. When completed, it presents the appearance shown at Fig. 14, *a* being the elevation and *b* the section, on a scale of about half the real size, and consists of a wooden cylinder 1½in. in diameter by 3⅝in. in length, with a deep channel round the ends and sides. To construct this pattern, procure a piece of pine 8in. long by 1½in. wide and ¾ of an inch thick. Lay this on a table on its widest side, and draw a line along its whole length, that shall divide it into two halves of ⅜ of an inch each. Now, draw a line on each side of this central line, rather better than ⅛in. from it. Holding a metal rule against one of these side lines, with a sharp penknife, cut into the wood along the line to a depth of about ⅜ of an inch—rather less than more. Now, perform the same operation on the other side line to the same depth. With a sharp ½in. chisel, shave away the wood on the outside of the cut lines to the depth of ⅜in. on the outsides, but *rising up very slightly toward the centre*, as shown at Fig. 14 *c*. This precaution will ensure the pattern lifting out clear from the mould.

Fig. 14.



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[illegible]

[illegible] which may be taken [illegible] ranging from [illegible]in. [illegible] and main pipes from [illegible]in.

[illegible] the number of branches [illegible] will supply. Multiply the [illegible] diameter of the main pipe in eighths, [illegible] the diameter of branch pipes in [illegible]

[illegible] is required to supply a building [illegible] pipes or fountain jets, what [illegible] main pipe will be required? For this look [illegible] for the number [illegible] in the main pipe [illegible] the size of main pipe [illegible]

[illegible] pipes [illegible] what [illegible] pipe will be required to supply these [illegible]

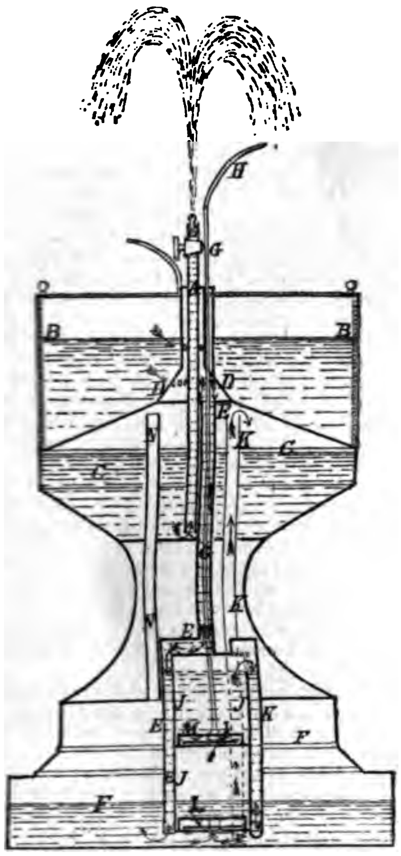
[illegible]

[illegible] which [illegible] circular inches. [illegible] size of pipe and [illegible] size of the [illegible] pipe.

[illegible] FOUNTAIN.

A [illegible] interested [illegible] fountains [illegible] will find a [illegible] Illustrated [illegible] diagram show [illegible] different [illegible] and [illegible] with a pump for com- [illegible] The upper end of the jet tube [illegible] trough or basin [illegible] and serving as [illegible] a jet or spray. The [illegible] near the [illegible] arranged below the trough [illegible] compression of the [illegible] the jet tube A. [illegible] the trough or basin [illegible] which the jet tube A [illegible] perforated to permit the [illegible] or basin B to pass into the [illegible] From the bottom of the trough [illegible] within the [illegible] D, a tube E [illegible] through the compression [illegible] and terminating near the [illegible] situated below the com- [illegible] tube serving, first, to [illegible] from the trough or basin B to [illegible] and, secondly, to allow of [illegible] pump rod G, the upper [illegible] a handle H outside [illegible] the pump works in [illegible] an opening in the [illegible] first downwards and [illegible] so as to form a U-shaped [illegible] then continued upwards, [illegible] of the compression [illegible] of the cylinder J is [illegible] a disc L, forming a [illegible] and a similar valve M is [illegible] so that as the piston I is [illegible] by its rod G, the water is [illegible] pump barrel or cylinder [illegible] valve L during the up- [illegible] downstroke passes the top [illegible] through its valve M, when the [illegible] through the U-shaped [illegible] compression chamber [illegible] connects the upper part of the [illegible] chamber C with the upper part of [illegible] chamber F, so as to allow air to pass [illegible]

[illegible] action of the pump raises the [illegible] chamber F to the compres- [illegible] compressing the air in [illegible] causing the water to be forced up [illegible] A and to issue in the form of a [illegible] spray, the duration of which will [illegible] the capacity of the compression [illegible] jet or spray continuing to play [illegible] chamber is entirely emptied. The compression of the air contained in the two chambers C and F is maintained by the water from the trough or basin B continually flowing down tube E and replacing the water issuing from the jet tube. The trough or basin B may be utilised as an aquarium, or it may be surrounded by a tray filled with earth so as to form a fernery. Instead of forming a trough or basin above the compression chamber, the water may be caused to descend directly to the lower chamber, and a small air pump or compressor be provided to compress the air in the compression chamber. Or instead of employing a pump to raise the water from the bottom chamber into the compression chamber, an air pump or compressor may be fitted to the former, so as to compress the air therein and force the water up a straight pipe or tube into the compression chamber, in which case the air tube between the two chambers would be fitted with a tap or cock, which would have to be closed during the forcing of the water up into the compression chamber, and which would be opened when all the water had been raised, when by two or three additional strokes of the air-pump or compressor the air would be compressed, and acting on the surface of the water force it up the jet-tube.



APPARATUS FOR ESTIMATING CARBON IN STEELS.*

A DESCRIPTION of the apparatus in use at the works of the Washburn and Moen Manufacturing Company, Philadelphia, will, I think, be of interest to those who desire an accurate method for the estimation of carbon in steels. The apparatus has been in use in the works for the past three months and has given entire satisfaction. The method of filtering carbon on to asbestos in a glass funnel, drying, transferring to a porcelain tube, and burning in a stream of oxygen gas, is accurate if all the carbon can be separated from the sides of the funnel, which in some cases is almost impossible. Again, the method of filtering on to asbestos in a platinum tube or boat-shaped apparatus, and putting all in a porcelain tube and burning as before, has also been used, and of course is less liable to error. My aim has been to do away entirely with the porcelain tube and combustion furnace, and to filter and burn in the same tube. The sketch shows the form of apparatus I have adopted, being made of platinum.

The following is the process I use: Dissolve from

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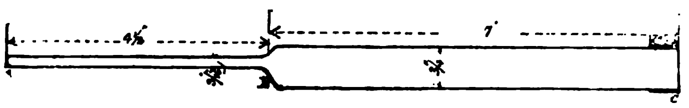
* By Addison B. Clemence, Worcester, Mass., in Journal of the Franklin Institute.

3 to 5grm. steel borings in double chloride copper and ammonium, using 36grm. of the salt to 120cc. water for 3grm. of steel.

After the separated copper has completely dissolved, filter on to a plug of ignited asbestos placed at (*b*), and wash thoroughly with hot water. Any carbon that adheres to the sides of the tube may be swept down with moistened asbestos.



The tube is then placed in an air-bath and dried at a temperature of 150° to 175°C. for about one hour. A hard rubber cork, through which is a glass tube, is inserted at (*c*), the oxygen gas passing from (*c*) to (*a*). Around the tube at (*c*) is a single thickness of filter paper, about two inches wide, kept wet by a stream of water supplied from a reservoir on a shelf above.

Heat is applied at (*b*) for one-half hour, at the end of which time the potash bulb is ready for the balance. One Bunsen burner is sufficient for the combustion. The same precautions are taken to dry the gas before entering the platinum tube, as well as before entering the potash bulb, as in the case in the porcelain tube method. Six burners of a combustion furnace will consume 14ft. gas in one-half hour, while one Bunsen burner will consume 2ft. in the same time. The following table shows some results obtained by the "platinum tube" process:—A is a Swedish Bessemer, with ·10 per cent. of carbon; B an American Bessemer, with ·18 per cent.; and C an American Bessemer, with ·50 per cent., all obtained by the "porcelain tube" process.

	A.	B.	C.
1....	·09	·18	·49
2....	·10	·18	·51
3....	·10	·16	·49
4....	·10	·17	·44

Note.—If pure, closely-woven asbestos cloth can be obtained, I see no reason why with two potash bulbs twelve combustions may not be made in one day, for each filter with its contents may, when dried, be put in the platinum tube and burned.

MYSTERY-MONGERING.

"MESMERISM," says the *Saturday Review*, "has long been the stand-by of the contemporary mystery-monger. Now, more than ever, when science is lighting up the shadiest places and forcing recognition everywhere, must the true lovers of the occult defend their cherished idol, and descend into the arena of conflict with the sceptics seemingly equipped with weapons such as theirs, but ready also with plenty of verbal dust to confuse the vision of the judges. The modern mystic, indeed, of whatever colour he may be, must masquerade in scientific clothes, and not one of the departments of 'psychical' researches provides so rich a wardrobe as mesmerism or animal magnetism. 'Thought reading' may be annihilated almost without an effort, and 'Haunted Houses' may totter and fall at the first assault; but there is a solid foundation of fact deeply underlying the alien and flimsy superstructure of mesmerism, which, on the one hand, the scientific man of course admits and explains, and, on the other, the mystic faithfully preserves, cunningly professing the while that foundation and superstructure are the same in substance. The facts of hypnotism, or induced somnambulism, are well known to physiologists, being parallel, moreover, to those which occur in certain spontaneous conditions of nervous subjects, and the explanation implied in these terms is allowed by the most modern apologists of mesmerism to be largely true, and to cover with a little straining nearly all mesmeric phenomena. But there is a residuum of fact in mesmerism, say these last, that necessitates the hypothesis of a hitherto unknown manifestation of force. The difference between superstition and science on this matter may thus at first sight seem to be a small one, and more of degree than kind; but a little inspection will show that it is wide and important. Only force the mystic to define his terms and classify his phenomena—an operation he does not readily perform—and have a clear understanding with him where hypnotism ends as an explanatory agent, and the sphere of mesmerism begins, and exactly at that point of junction will rigid demonstration be found wanting, and the possibility, nay, the overwhelming probability, of imposture and collusion appear. But, to avoid this direct issue, it is a favourite device of the believers in mesmerism to falsely declare that the whole class of phenomena they adduce are stoutly denied and pronounced impossible by all scientific men.

The physiologist holds that some of the phenomena ranked under mesmerism are genuine and comparable to certain natural states, but that none exist to justify the supposition of any unknown force or effluence, most mesmeric manifestations of a certain sort being entirely due to individual or collusive fraud. For most of the facts alleged are of such a nature that it is infinitely more probable that all connected with them, both actors and reporters, are deliberate impostors, than that they should themselves be true. But the mystics refuse this logical standpoint, and argue, tacitly or openly, that the same amount and kind of evidence is valid both for the commonplace and for the unknown. It may be roughly said that the phenomena of so-called mesmerism which have long been familiar to all, and have from time to time excited the public mind, are mainly represented by actions formed by one person apparently under the influence of another, the subject being, for the most part, thrown into a more or less unconscious condition, and often alleged to be beyond the reach of any known means of communication by the senses. These phenomena, compounded of the true and the absolutely false, have been treated by different minds and methods. Science has sifted the alleged facts, and ascribed, with a large share of success, the established residuum to intelligible causes; while superstition has sought and specially cherished that element which apparently, on the supposition of its being genuine, could not be explained at all. In spite of the pseudo-scientific garb which mysticism has assumed in recent times, and of all protestation to the contrary, the love of the occult shines confessed in the credulous statements and writings of those who advocate the genuineness of the mesmeric phenomena which science rejects, showing itself, too, in their alliance with devotees of other, though similar, mysteries, in a captious impatience of the ordinary methods of investigation, and a constant seeking after new phenomena when some of the old have been completely explained or explained away. It is perhaps useless for these two classes of mind to seek for common ground; the ways of the scientific inquirer and the 'psychical' researcher can never meet; they cannot argue or experiment in common. The former, in his search for truth, is content to explain by simplification, and proceed from the unknown to the known, while the latter practically proclaims that nothing can be known at all. The scientific reasoner rests on the surest basis of the greatest probability; while to his opponent, with the quibble on his lips that probability is not certainty, the most rigid demonstration appears a trifle light as air, or even no probability at all."

PREVENTING INCRUSTATION IN BOILERS.

THE report of the engineer of the Manchester Steam Users' Association, presented at the recent meeting of the executive committee, after detailing the work done in the preceding four months, dealt at considerable length with the subject of the prevention of incrustation in steam boilers, a subject of great importance to boiler owners, and one which had for many years received attention from the Association. In 1858 the Association engaged Dr. R. Angus Smith to make an analysis of several of the waters used in the works around Manchester, and to prescribe remedies for their treatment, in order to guide the members on this subject. Subsequently several other analyses had been made of water containing carbonate of lime coupled with magnesia. Such waters were found to form a fine floury deposit, which led to the overheating of the furnace plates, even though covered with water at the time. In consequence of this many boiler makers had been unfairly blamed, and the straining of the furnaces attributed to bad workmanship, whereas it was due to the peculiar character of the feedwater. Cases of this sort had been met with in different parts of the country, in London, in Lancaster, in the neighbourhood of Widnes, and many other localities.

The number of anti-incrustation compositions was very numerous. Their component parts were veiled in mystery. Many of them proved positively injurious to the boilers on actual trial. Some lined the plates with a glutinous coating, which, while it had the desired effect of keeping off the scale, unfortunately at the same time kept off the water, in consequence of which the furnace crowns became overheated, strained, and bulged out of shape. The members therefore were warned not to adopt any of these compositions without the greatest caution. As the incrustation compositions were costly, blowing out was too often given up when they were used. The practice of neglecting blowing out was strongly objected to, and an explosion that occurred at Bury from that cause was referred to as an illustration.

The course recommended by the Association was to try in the first instance good soda ash. This was not to be introduced at the manhole or safety valve in large intermittent charges when the steam was down, but pumped in along with the feedwater at the rate of about 3lb. per day for a full-sized mill boiler so that the boiler might regularly be fed with weak soda water, while blowing out should by no means be neglected.

Boilers were not to be emptied violently by blowing the water out under steam pressure, as that would leave the surrounding brickwork hot, and bake the sediment on the plates; but the boilers were to be allowed to stand until cool, and then emptied gently by opening the blow-out tap and allowing the water to flow out of its own accord. To hasten the cooling the steam might be blown off at the safty valves, and then when the pressure was down, but not before, the manhole lid might be taken off and cold water poured in so as to mix with the hot, and thus lower the temperature of the mass gradually and generally, and not suddenly and locally.

Should, however, the soda not be found to succeed, and soda would not meet every case, it was recommended that an analysis of the water should be made by a practical chemist with a view to a suitable remedy being prescribed to meet the special requirements.

Soda ash was recommended in preference to soda crystals, because the crystals contained so large an amount of water, so that though the soda ash might cost a little more per pound in the first instance it was cheaper in the long run. It was stated, however, that as soda ash varied very much in quality it was important to see that it was good, as otherwise it might contain impurities which were injurious. In one case which had come under notice, the amount of carbonate contained was only 65 per cent., while in another it was as much as 98 per cent. Also in the first case the quantity of chloride and sulphate of sodium, which were impurities, was as high as 18 per cent., and in the second case as low as 0·5 per cent. Further, there was present in the first case as much as 16 per cent. of water, and only 0·3 per cent. in the second. Thus there was a marked difference between the two.

The report also spoke of the Porter-Clark process which had been adopted by some of the members. This process had the advantage of purifying the water before it was pumped into the boiler, whereas all boiler compositions treated the water after it was pumped in, so that while the Porter-Clark process threw down the impurities outside the boiler the compositions threw them down inside. The Porter-Clark process, however, at present was only adapted to deal with carbonates, whereas most of the waters the Association met with were impregnated with sulphates. It was hoped that the Porter-Clark process might be extended so as to render it applicable to waters impregnated with sulphate of lime as well as to those impregnated with carbonate of lime.

BLEACHING SPONGE.

THERE are several methods by which sponge may be bleached, but the following are the best:

1. First wash and squeeze out the sponges; then dip them into a 2 per cent. solution of permanganate of potassium. Here they become quite brown (from separated manganic oxide). After ten minutes they are taken out, washed in water, again well pressed, and then dipped into a 2 per cent. solution of oxalic acid—some prefer diluted sulphuric (1 : 20) or diluted hydrochloric acid (1 : 15)—in which they become perfectly white. Success mainly depends on the soaking in the permanganate solution. If they are macerated too short a time, they do not become thoroughly white; if too long, they are apt to become rotten.

2. Clean the sponges by immersing them in diluted hydrochloric acid; then soak them in a bleach, composed of hyposulphite of sodium one part, water twelve parts, and hydrochloric acid two parts. After some time remove and well wash. To the last wash-water a little glycerine is added in order to preserve the sponge soft. The liquid is best pressed out by passing the sponge through a clothes-wringer.

3. Toilet sponges which have been in use often become peculiarly slimy and almost useless, owing to some action of the soap. Mere washing in distilled water does not remove the dirt. The sponge should be pressed as much as possible, placed on a plate, and powdered chloride of calcium sprinkled over it and allowed to deliquesce upon the sponge. After about half an hour the sponge may be washed in water and dried, when it will become white.

All the above processes furnish satisfactory re-

[illegible]

[illegible] of [illegible] acid is contained in the [illegible] when they are of a [illegible] colour, but the amount is very [illegible] the berries are quite ripe, or when

SCIENTIFIC NEWS.

T[illegible] Tempel's comet (1873 II.) [illegible] midnight on Nov. 24, is [illegible] N.P.D. 114° 13·1', ac-[illegible] elements. D'Arrest's [illegible] M. Leveau's ephemeris, [illegible] Nov. 24, R.A. [illegible]

[illegible] annual report of the [illegible] Astronomical [illegible] director of the [illegible] Knight and [illegible] news which it contains [illegible] previous pub-[illegible] is the notes on [illegible] the red spot, [illegible] drawings of the [illegible] 1882, and Feb., [illegible] the statement [illegible] that in the course [illegible] formed on Jupiter, [illegible] of the observa-[illegible] realise that they [illegible] a plane surface, [illegible] apparent size with their [illegible]

[illegible] worlds heard on [illegible] regret, that Sir [illegible] the previous even-[illegible] his acquaintances and [illegible] William had met with a fall on [illegible] was shaken a good deal, [illegible] that it was more than a [illegible] Unfortunately, it appears that [illegible] the heart, and the distinguished [illegible] science expired almost sud-[illegible] 19th inst. Carl Wilhelm Siemens [illegible] Lenthe, in Hanover, on the 4th of [illegible] He was educated at the Gymnasium [illegible] afterwards at the Polytechnic School [illegible] and finally at the University of [illegible] studied under Wohler and [illegible] pupil in the engine [illegible] and there he laid the [illegible] know-[illegible] practical [illegible] the English [illegible] his own and his [illegible] William [illegible] This was in [illegible] Siemens, in con-[illegible] then pupil, [illegible] regenerative [illegible] purposes. The first [illegible] was in [illegible] experimenting the [illegible] was perfected. [illegible] Siemens-Martin process. [illegible] of Sir [illegible] common in [illegible] any particular [illegible] everybody as a [illegible] Dr. Siemens [illegible] ways of solving [illegible] was elected a Fellow [illegible] He became a [illegible] Engineers in [illegible] President of the Society [illegible] and served a second [illegible] He has been President of [illegible] Engineers, of the [illegible] and of the British Asso-[illegible] Council of the [illegible] was to have delivered the [illegible] that Society's session last [illegible]

[illegible] death [illegible] of Dr. J. Lawrence Smith, Professor [illegible] in the University [illegible] Kentucky, and well known by his [illegible]—a study he had made [illegible] Dr. Smith finished his education in Paris, and contributed many papers to the scientific societies of that city.

The death is also announced of Dr. R. S. Hudson, the Secretary of the Miners' Association of Cornwall and Devon. He had been engaged for many years in introducing practical science to the miners by means of lectures and letters.

The Royal Dublin Society has appointed a committee to consider the best system of founding an Irish college of veterinary science, with power to confer degrees.

Continuing his series of lectures at the London

Institution, Mr. Skertchly, referring to the "fossil man," said that the evidence of man's antiquity on the globe was of a twofold nature, geological and archæological; the latter is found in the ground and polished celts which mark a distinct change from the age when flints were chipped; the former in the positions of the implement-bearing beds, some of which are below a very ancient glacial deposit. In the lecture on "Prehistoric Man," Mr. Skertchly illustrated practically the method of chipping flints, and gave a description of the flint mines of Brandon, and an account of the modern "flint knappers," who are supposed to be lineal descendants of the old workers amongst the Neolithic people. We reviewed Mr. Skertchly's work on this subject in Vol. XXIX. p. 482.

M. Dieulafait has recently presented to the Academy of Sciences a memoir on the extent and age of the Dioritic formations of Corsica, in which he shows that the Corsican diorites belong to three distinct systems: granites at San Lucia, di Tollana, and Ajaccio, the serpentine rocks of the Triassic, and Permian formations at Bastia and other places. With the last are associated exclusively the metalliferous sulphides which occur in the island.

There is a possibility that, before long, Switzerland will have a patent law, the result of the recent exhibition at Zurich having convinced the authorities that owners of new machines declined to exhibit on the ground that they had no protection from the enterprise of mere copyists.

The Gaulard and Gibbs system of electric lighting is now at work on the Metropolitan Railway at Notting Hill-gate, Edgware-road, and Aldgate. King's-cross and Gower-street will soon follow. The total length of the leads and return is 15 miles. The installation will be watched with some interest, for the current actually used to supply the lamps is produced by secondary generators. The primary circuit is said to be "metallically closed," and, consequently, carries an E. M. F. of 2,000 volts, without running any risk of accidentally injuring anyone.

Messrs. Shippey Brothers inform us that the carriage of the ex-Lord Mayor was illuminated by electricity whilst proceeding to and from the banquet at the Guildhall on the 9th. New universal glow lamps were used, the current being generated by Coad's patent primary battery in combination with the Woodward storage battery. As this is the "first time a carriage has been lighted by electricity in England," it is an item of news: but there is no difficulty in doing it, if owners of carriages like to pay the price.

The deepest well in the world is said to be Buchanan well, near Wheeling, West Virginia, which is 4,300ft. deep, and is still "going down." Oil has been struck, and it is intended to go 500ft. deeper; but, if necessary, the hole can be bored to a depth of 7,000ft.

It has at last been officially stated that applications for patents made before the 1st of January, 1884, will be subject to the old law as regards fees and procedure up to and including the filing of the final specification. The words, "or on applications then pending," in clause 3, section 45, of the new Act, should obviously not have been inserted, or the authorities are over-riding the law.

We are informed that Lieut.-Col. Ross has completed arrangements with Messrs. Crosby Lockwood and Co., 7, Stationers' Hall-court, London, for the publication, in book form, of the "Easy Lessons on Blowpipe Analysis," &c., which have recently appeared in the pages of the ENGLISH MECHANIC. The work, which has undergone considerable revision, will be issued at a moderate price, under the title of "The Blowpipe in Chemistry, Mineralogy, and Geology," and will include many additional tables and illustrations, and about forty analyses of minerals from the note-book of a student at Freiberg University, with a parallel analysis on Col. Ross's new system appended to each.

According to the report of the Science and Art Department, the sum of £45,376 (out of over £340,000 income from Parliament) was spent last year in payments to science teachers. The average payment for each class of at least twenty-eight lectures, lasting from September to May, being slightly more than nine pounds. Inspecting and examining the classes cost £22,235.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

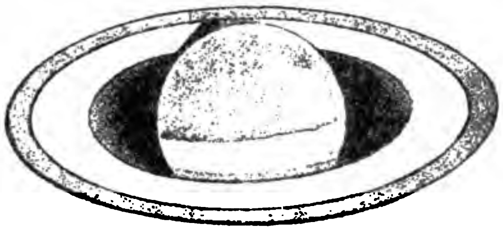
All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

THE PLANET SATURN—A TOO AMPLE APOLOGY — CEMENTING OBJECT-GLASSES—HEIGHT OF THE MIDNIGHT SUN—THE TRANSIT INSTRUMENT AND ITS ADJUSTMENT—READING THE CIRCLES OF AN EQUATOREAL—THE LAST SUNSPOT MAXIMUM—SATURN'S SATELLITES AND DARK RING—THE TIME OF THE EARTH'S ROTATION; AND THE RECENT RESEARCHES OF MR. STONE — THE ANNUAL REPORT OF THE CHICAGO ASTRONOMICAL SOCIETY —POWERS FOR OBSERVING PLANETS — 41 ARIETIS — THE SOLAR RICE GRAINS—SPECTRUM ANALYSIS.

[22053.]—HERE is the sketch of Saturn which I made on the night of November 9th, in redemption of my promise to Mr. Franks, on p. 217.

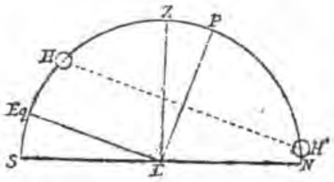


If the engraver will only reproduce accurately what I drew most carefully at the telescope, this will serve to illustrate the kind and amount of difference in the details exhibited by a 11¼in. reflector and a 4⅛in. achromatic when turned upon this planet. My own drawing—and I hope the engraving too—shows how I fail to see the inner edge of the crape ring C in the Ansæ as absolutely continuous with that portion of it which crosses the ball of Saturn. This is apparently from want of sufficient light. By the bye, the visibility and the colour of this inner ring varies very considerably. It was by no means conspicuous on Friday week, and was of a very dark grey colour. I have, however, often seen it of a bright slate colour, and also (if my memory serves me) brownish on occasion. Under the former condition it was, I had almost written, *glaringly* visible. Tethys, Dione, Rhea, and Titan were all visible when my sketch was made. I did not look for Iapetus.

Let me hasten to assure "Bow" (letter 22923, p. 221), that in no sense whatever could I possibly regard his note in letter 21996 as "a piece of impertinence." Referring to that excellent old lexicographer, Bailey, I find that his first definition of impertinent is "not to the purpose"; while the next dictionary I take down, that of Walker, defines impertinence as "That which is of no present weight, that which has no relation to the matter in hand." In what sense the supply of an omission which I made (writing as "Bow" but too truly says, *currente calamo*), can be held to come within either of these categories, I wholly fail to see. I am only too much obliged to him for pointing out that my answer failed in fulness.

In answer to the query contained in reply 51961 (p. 225), I have a strong impression, well or ill-founded, that Wray, the great optician, patented a process for the construction of object-glasses, in which castor-oil was employed as a medium between the crown and flint lenses. His object was, if I remember rightly, to destroy the secondary spectrum, so as to render the combination absolutely, and not merely approximately, achromatic.

"C. B. T." (query 52170, p. 227) may calculate the height of the midnight sun by simply subtracting the sun's North Polar distance from the latitude. A glance at the accompanying figure will explain how and why.



My querist, of course, knows that at any given part of the earth's surface the latitude = the elevation of the Pole above the horizon. Very well, then; in the diagram above, let E be the observer's eye: S E N, the horizon; Z, the zenith; P, the North Pole of the heavens; and P N its altitude, of course, in this case, 71° 10′ 20″, Eq., E will be the equator. Now, on June 21st, at midnight, the sun's declination Eq. H. is 23° 27′ 5″, and quite obviously his north polar distance P H is 66° 32′ 55″. If, then, finally from 71° 10′ 20″ we subtract 66° 32′ 55″, we get 4° 37′ 25″ (H¹N in our figure) as the altitude of the sun when due north, or at midnight. This is evidently his geometrical altitude. Refraction will increase this, and make his apparent altitude 4° 48′ 2″. On July 21st, at midnight, the declination of the sun is 20° 24′ 32″ north, and his north polar distance 69° 35′ 28″. Taking this latter latter quantity, as before, from the latitude 71° 10′ 20″, we get 1° 34′ 52″ as the geometrial altitude of the sun's centre at the North Cape on July 21st, 12h. 0m. 0s.; or, adding 20′ 38″ for refraction, 1° 55′ 30″ as his apparent altitude above the north point of the horizon there at midnight on that day.

I do not fancy that either Simms or Cook has wired the transit instrument spoken of by "Clock Star" (in query 52172, p. 227). The spider lines have probably been put in by some apprentice. As for taking his transits over the middle wire only, though, this depends upon whether such wire is accurately collimated, in other words, if it actually coincides with the optical axis of the telescope, and is really the *middle* wire. I presume that your correspondent knows how to collimate his instrument? If its collimation be accurate, I really think that for "Clock Star's" purpose transits over the centre wire only would be as accurate as he would be likely to get; as every observation would otherwise have to be reduced to the "mean wire," which differs materially from the middle one. In order to get his transit into the meridian, "Clock Star" had better carefully level its axis and then obtain his clock error by a star as near as may be to the zenith; such, for example as α Cassiopeiæ, α Persei, Capella, ι Ursæ Majoris, θ Ursæ Majoris, γ Ursæ Majoris, η Ursæ Majoris, β Draconis, γ Draconis, or α Cygni. His clock error thus determined, let him apply it to the tabular Right Ascension of Polaris, and threading the Pole star on the wire as it approaches the Meridian, keep it on such wire by the azimuth screw until the clock ticks the second which he has calculated it should show at the star's transit. His instrument will be very nearly indeed in the Meridian. High and low stars are better for determining azimuthal error with small transits such as his than circumpolars, but I am speaking of getting the transit as nearly as may be into the meridian, not of ascertaining the exact amount of its subsequent deviation from it.

In answer to the succeeding query (52173, p. 227), I have not seen Grubb's arrangement; but I have employed, in a friend's observatory, Cook's method of reading the circles of an equatoreal from the eye-end, which—as far as my limited experience enabled me to judge—was very pleasant, and free from objection.

I should prefer to wait for Wolf's results before attempting to answer query 52185 (p. 228), since they will be arrived at on purely scientific grounds, and without any *arrière pensée*, or attempt to "cook" them to fit in with any "cycle," real or imaginary. The maximum of sunspots must, I think, have occurred pretty late in 1882.

"Aziola" (query 52186, p. 228) should endeavour

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51[illegible].]—**Three-Cell Battery.**—Referring to "Electrician," I should be glad if he would be good enough to let me know the length of time it will continue to light a lamp before it runs down. What size cells, what size carbons, and zincs?—No Sig.

[51848.]—**Lost Watch Wheel.**—Having given some examples for calculating trains, and finding numbers for the teeth of a "lost wheel and pinion," in "E. M.," Oct. 19th and 26th, I hope the following will be useful by showing how the time of going can be calculated, and also the "up and down" motion. It will be seen in the above-quoted numbers, that all those relating to "lost watch wheel" were calculated from the centre wheel upward to the balance vibrations, and that only one rev. of centre wheel was taken into account, and consequently only one hour of time; but if a watch or any other timepiece is to go 30 hours, or more, then we start from the centre pinion downwards, which pinion may be any number we like (so long as not to make the teeth too fine or weak): usually the c.p. has from 10 to 14 leaves: let us use a 12. Now, to find numbers for great wheel, the centre pinion also turns to be cut on the fusee, or if a going barrel, then the number of teeth in the wheel and turns the barrel must make to go any number of hours we wish without rewinding, and the number of hours of going. Of these parts we must fix on three to find the fourth. Let c.p. = 12 leaves, fusee or barrel = 4 turns, to go 30 hours: find number of great or barrel wheel teeth. Rule 1: [illegible] number of hours by number of turns of fusee or barrel by the quo. [illegible] c.p. Example 1. 30hs. ÷ 4 turns = 7½ quo. [illegible] 12 c.p. = 90 wh.: now 90 wh. ÷ 12 c.p. = 7½hs., which being × 4 turns = 30hs., because the c.p. makes one exact rev. in an hour, the gt. wheel in 7½ hours, and 4 in 30 hours. To find number of turns of fusee or barrel. Given, number of gt. wheel, c.p., and hours of going. Rule 2. Divide great wheel by c.p., and hours of going the quo. = turns of fusee or barrel. Ex. 2. 90 wheel ÷ 12 c.p. = 7½, 30 ÷ 7½ = 4 turns. To find number of c.p. Given, great wheel, hours of going, and turns of fusee or barrel. Rule 3. Divide great wheel by number of hours of going, the quo. × by turns of fusee = number of c.p. [illegible] [illegible] great wheel. [illegible]

[illegible]

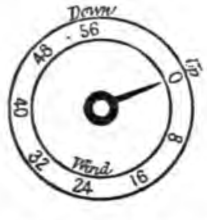
[illegible] number pinion in [illegible] considered two [illegible] 3, they [illegible] wheel 96, inter. pinion [illegible] if the pinions be two [illegible] = 32 [illegible] as at first; then [illegible] 4 = 12, [illegible] two pinions. To prove these numbers are right, multiply each pair of wheels together, and divide by the product of the pinions.

$$G\left\{\begin{array}{lllll}\text{1st Ex.,} & 90 \times 64 = 5760 \div 120 = 48 \\ \text{2nd ,,} & 135 \times 96 = 1296 \div 270 = 48 \\ \text{3rd ,,} & 108 \times 64 = 6912 \div 144 = 48\end{array}\right\} =$$

revs. of c.p. to once of fusee wheel, and, as the c.p is made to revolve once in an hour, the fusee wheel will revolve only once in two days, so that 18 turns of the fusee will employ 36 days, when all the chain will be unwound off the fusee on to the barrel. Rule 4. To find time of going, divide great wheel by c.p. the quotient, multiply by turns on fusee (or turns of barrel), equal time of going. Ex. 4. Given great wheel 90, c.p. 12, turns 4, then 90 ÷ 12 = 7½ × 4 = 30; if an inter. wheel and pinion be used (as in some 8 days or month), then, product of great and inter. wheels, divided by product of centre and inter. pinions, the quotient multiplied by turns of fusee or barrel, equal number of hours. Ex. 4*a*.—Given

$$\begin{array}{c}G \\ \text{Ex. 3}\end{array}\left\{\begin{array}{lr}\text{Great wheel} & 108 \\ \text{inter. ,,} & \times\ 64 \\ \text{centre pinion} & 12 \\ \text{inter. ,,} & \times\ 12\end{array}\right.\begin{array}{l}\}\ 6912 \\ \\ \}\ 144\end{array} = 48$$

× 18 turns = 864 hours = 36 days. The "up and down" motion is to show when the watch is wound up, how many hours it has gone since last winding, and when run down. The accompanying sketch of a 56 hour watch will make this clear. The circle



is divided into nine equal parts, seven being used, and every eighth hour marked from 0 to 56 (8 hours more than two days, as the watch is made to go that time, just as a one day is made to go 30 hours). Now an arc less than a circle can be used; in the above 280° are taken, and is similar to a two-day marine chronometer up and down circle. The wheel and pinion work consists usually of only one each, though sometimes two wheels and two pinions, in the former the pinion is fixed to the fusee pivot and gears into the hand wheel, so called because the up and down hand is fixed on the wheel's socket, which comes through the dial, and a little above it, so that as the fusee revolves, carrying the pinion, leads the wheel round, also the hand fixed on it, and when the watch is wound up the hand is again brought to O. A rule for calculating this motion is as follows: Given eight turns of fusee, nut pinion 10, arc of up and dn. circle = 280°, time of going 56 hours. To find No. of hand wheel, Ex. 5: multiply turns of fusee by No. of leaves in nut, thus 8 × 10 = 80, then, say, as 280° : 80 :: 360° : x = 102⁶⁄₇. Now we cannot have ⁶⁄₇ of a tooth, so we must proceed as follows:—Multiply whole number 102 by the denominator of the fraction. Add the numerator: thus 7 × 102 = 714 + 6 = 720; multiply the pinion 10 by the 7 = 70: much too high, so divide by 10. We get 72 and 7. Too low, but × 2 = 144 and 14. These numbers would do very well, the nut having a good body and the wheel being easily cut. Had we taken 300° of arc, a wheel 96 and a pinion of 10 would have done very well, as 10 × 8 = 80, then 300° : 80 :: 360 : 96, and dividing the arc into seven equal parts, marked as above, all would be right. Sometimes it is expedient to have two wheels and two pinions. First calculate as for one pair. Take the last numbers, multiply each by 10, we get—

$$\begin{array}{ccccccc} & & \multicolumn{2}{c}{\text{Wheel.}} & \multicolumn{2}{c}{\text{Pinion.}} & \\ 32 & \left\{\begin{array}{c}2\\4\\4\\30\end{array}\right. & \begin{array}{r}960\\480\\120\\30\end{array} & & \begin{array}{r}2\\2\\5\\5\end{array} & \begin{array}{r}100\\50\\25\\5\end{array} & \begin{array}{l}\}\ 10\\ \\ \}\ 10\\ \end{array}\end{array}$$

one nut fixed on fusee pivot and one on wheel 30, 32 carrying the hand. When it is necessary to plant the hand wheel at such a distance from the fusee that it cannot gear into the nut pinion fixed on the pivot, a wheel, or any number of wheels, may intervene (providing they have no pinions gearing); in such a case, the revs. of nut pinion fixed on the fusee pivot are to the hand wheel just the same as if they were geared into each other, the direction only being altered; that is, if one wheel intervene the hand wheel would revolve same way as the pinion; if two, then contrary, and so on *ad infinitum*. Before closing this subject, allow me to say that I have taken most of the foregoing from "Reid on Watch and Clockmaking," page 12, and following pages, but the method of finding "lost watch wheel and pinion" I think is due to—R. E. B.

[51879.]—**Locomotives (U.Q.)**—To "St. Aubins."—I have not my "Molesworth" at present by me, but can remember the pages to which you refer. The 9in. passenger is a Caledonian tank (single-wheel). The 10in. passenger was built for the Eastern Union Railway (four-coupled 5ft.) The 17 tank broad gauge was a 6ft. four-coupled tank G.W.R. The 18in. English goods engine was Sharp's Goods M.S.L.R. Those in the other list I do not at present remember.—Carstairs.

[51898.]—**N.B.R. Engines.**—"Glasgow" 474, and "Berwick" 475. Cylinders, 17in. by 24in.; leading and trailing wheels, 4ft. 6in.; driving wheels, 7ft.; rail to top of chimney, 13ft.—Carstairs.

[51912.]—**To Violinists who are Mathematicians.**—"Student," on page 179, states that he is informed that a person who has learnt music on the tonic-sol-fa system can tune a violin quicker than a person who has learnt on the ordinary method, and he asks whether any sol-fa-ist who is a mathematician can throw any light on the matter. As a sol-fa-ist, I must say that I think it is not so much a question of mathematics as of musical training. My experience is that the tonic-sol-fa method of teaching music endows its student with a delicate sense of interval, which I find from close observation is less acute in persons taught on the old system. The interval of a fifth is taken as from doh to soh (upwards) and the interval is the same between each adjoining string on the violin. I have had but little practice on the instrument, and am therefore anything but a good performer; but I experience no difficulty in tuning it perfectly true, and can instantly tell whether it is in tune by merely gently plucking each string in succession, and do not require to draw the bow over two strings at once in order to test the chord. It has often astonished me to hear persons who are fairly good performers on the instrument make such a bungle of tuning it. At a class to which I belong I have often heard some of them start playing when a trifle out of tune, evidently under the impression that all was right. I invariably find that where this defect exists the performers are old-notationists, and that it exists in its most exaggerated form amongst those who have learnt music on what is termed the fixed doh system.—M. W.

[51936.]—**Crystal v. Paraffin Oil.**—Doubtful if there is any method of distinguishing between what are practically identical; but for "paraffin" I suspect is to be read petroleum, or kerosene. Then the "crystal" oil is doubtless better refined, and shows least colour. For any useful method, however, of simply testing, it would be best to procure samples of the articles, and observe the differences of colour when placed in tall, narrow glass vessels. The clearest is the best—provided it is not benzoline; but you will use the flashing test for that.—Nun. Dor.

[51944.]—**Coppered Wire.**—I wish to inform "Ressorp" that the term "copperas" is applied to three metallic sulphates; that of copper is called blue, of iron green, and of zinc white copperas. A druggist, if a Londoner, would, on being asked for copperas, inquire which sort was wanted.—W. G.

[51944.]—**Coppered Wire.**—It appears that I have not worded my last remark on this subject in a sufficiently explicit manner. What I meant to say was, that if the copper sulphate solution is strongly acid, the copper will adhere more strongly to the wire than if it is only slightly so. I did not, of course, mean to say that querist was to use an unlimited supply of acid, and only very little copper sulphate.—R. A. R. Bennett.

[51944.]—**Coppered Wire.**—Iron or steel can be coppered by placing in a solution of tartrate of copper, which is made as follows:—In a solution of sulphate of copper pour a solution of caustic soda; the precipitate will be oxide of copper, which must be washed with cold water to free it from any acid; then dissolve in a solution of tartaric acid. Place the articles to be coppered on a piece of zinc, and immerse them in the solution.—Les Dents.

[51944.]—**Coppered Wire.**—This is a nice little bit of logomachy about "copperas," isn't it? I suppose I may express the opinion that, although copperas is the name of crude sulphate of iron (though why it should be, goodness only knows), I suspect if you go into an oilshop or drysalter's and ask for it, as often as not they will ask which you mean. At least as far back as I can remember there were blue, green, and white "copperas," a word that is sometimes supplanted by vitriol; and there was also calcined copperas, being the calcined green vitriol which was used as an astringent and as driers. Iron pyrites is also sometimes called copperas. It would be really interesting to learn how a salt of iron came to be called copper-as.—Nun. Dor.

[51950.]—**Loss of Smell.**—How can any one even suggest anything without knowing *why* our unfortunate friend has lost his sense of smell? Has he consulted a medical man?—Nun. Dor.

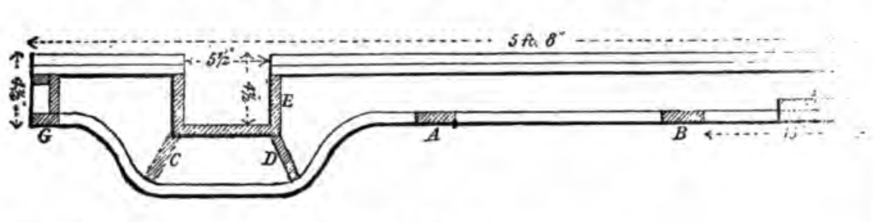
[51967.]—**Seasoning Boxwood.**—Box is not liable to heart-shake, but does split spirally, which cannot be prevented. Better stack it in the usual way, under cover.—Nun. Dor.

[51990.]—**Carriage Lift.**—Cannot "Tynedale" rig up an inclined plane, and lower the carriages down that? Or can he not make a lift, to be raised by a differential pulley? I suppose a crane is out of the question; but there is not sufficient detail in the query to enable one to say which arrangement would be best.—NUN. DOR.

[52033.]—**Caledonian Engines.**—Since writing my last, three of the goods engines by Neilson have been turned out—viz., Nos. 294 to 296 (the class will be 294 to 308), and one from St. Rollox, No. 349. They are painted like the passenger engines —i.e., blue and frames morone, lined with black, and picked out with white. The rebuilds are doing rather better now.—CARSTAIRS.

[52043.]—**Induction Coil.**—To L. WILLIS.—Probably the insulation is not as perfect as it might be. After you have wound on the two layers of primary, insulate it from secondary with paraffin paper, and bake with paraffin wax; then after each layer of secondary a piece of the paper, and so on, till all secondary is wound; the wire should be wound as smoothly as possible. The amount of battery power the coil will stand depends on insulation. I use Bunsen's battery, with 7in. carbon. —ALEX. V. NICHOLLS.

[52074.]—**Lathe.**—I give the longitudinal sketch of bed asked for by J. H. The shaded parts are the webs. I made a mistake on p. 183, in that the shaded part occurs again 4ft. from the mandrel end; on referring to my drawings I see it does not. A and B and G are 2in. × ¾in. thick, C and D are ⅝in. thick, E ¾in. thick, F is 2in. × 11in., and is for fixing an additional piece of bed. I wish to know if these sizes are sufficient. I have adopted this form in preference to the ordinary double flat bed, as I find this has more disadvantages than advantages; for the headstocks soon work loose in a gritty atmosphere.—SHAKESPEAR, Dresden.



[52083.]—**Punching Machine.**—I have to thank "Loanhead" and S. Nichollis for their answers. I have gone a little more fully into the question, and I find the punch 2in., but the hole in the "bolster" 2¼in. Now, for the quality of steel which was punched, 34 tons per square inch is allowed, and the thickness of the plate $2\frac{1}{16}$in. What is the pressure required in tons, and how do you arrive at it?—CRADO.

[52103.]—**Engine.**—I hope "Engineer, Dewsbury," will send his promised letter on compound engines, showing the "loss," as compared with a single-cylinder engine having the same number of expansions. That will indeed be carrying the war into the enemy's country; and I hope "Engineer" will take care to "keep his communications open," or he may lose himself. I know that a good single-cylinder engine can be made to give an economy very nearly approaching that of the compound; but never yet heard of one that really beat a good compound.—ESSAR.

[52125.]—**Harmonium.**—Might I ask Mr. Fryer what size holes he makes at the top of the windtrunks to supply the reservoir of the harmonium whose valve-board has holes of the dimensions given on p. 248? Will he also say how he fits the escapements for his valves?—FLIEGEN.

[52165.]—**Slide-Rule Formulæ.**—Corrections: —"60." before "For simplicity," eighth line from top, and "60" before "Slide-rule formulæ," 15th ditto, should be "or."—BUTTERSHAW.

[52165.]—**Slide-Rule Formulæ.**—The question to be solved is this: Given the rate in feet per minute of the piston of a direct-acting pump, and the number of cubic feet of water that it is required to deliver—to find diameter of the pump in inches. "Glatton" requires to know how the number 183 is obtained in connection with above question when worked on the common single slide-rule. The number 183 is called the "gauge point"—that is to say, it is a number obtained to facilitate the working of all such questions on the slide-rule. To obtain it we must go direct to the bottom of the subject.

Let x = dia. of pump in feet. (For the other dimensions are in feet.)
c = c feet of water delivered per minute.
b = the rate per minute in feet that the piston travels.

The quantity of water delivered per minute is evidently equal to the number of feet that the piston travels per minute multiplied by the area of the pump. The area of the pump is equal to $x^2 \cdot 7854$. Hence,

$$c = bx^2 \cdot 7854.$$

$$\therefore \quad \frac{c}{b \cdot 7854} = x^2 \text{ (in feet).}$$

As there are 12in. in a foot, and 144 is the square of 12, it follows that

$$\frac{c}{b} \times \frac{144}{\cdot 7854} = x^2 \text{ (in inches.)}$$

That is—

$$\frac{c}{b}\ 183 \text{ nearly} = x^2,$$

which is reduced to the form required for slide-rule calculation thus—

$$\frac{183}{b} = \frac{x^2}{c}.$$

Therefore, if b, the rate per minute, be placed under 183 (which number, it will be perceived, is quite independent of all the other members of the equation, hence it is applicable to all similar questions). Then, over c the cubic feet of water delivered per minute will be found the square of x, the diameter sought. But as the slide-rule is so constructed that the line D is the square root of the numbers in line A, we read the square root at once under c without reference to the line A. Example:

Let c = 30 c. feet per minute.
b = 120 lin. feet per minute.

Thus, by slide-rule—

A	183	
B	120	
C		30
D		6·75

Hence 6¾in. is the required diameter. It has been said that 183 is the "gauge point" for the present question. It is this gauge point that has been the chief cause of the slide-rule not getting into more general use, for such a multitude of questions require a previous calculation to ascertain the correct gauge point before the question can be solved on the single slide-rule. If "Glatton" looks into all published works upon the slide-rule, either Bailey, Ingram, Hoare, or the more recent one, Dixon, he will find them overladen with gauge points, so that the calculator must either recollect them, or have the book to refer to, before he can work out the question by slide-rule practice. In fact he must study slide-rule arithmetic to know what rules and gauge points are to be used. Sheppard's double slide-rule for cubing quantities, made for and sold by Stanley, Great Turnstile, Holborn, does away with the host of "gauge points," except in the most abstruse cases, which seldom occur. The operator has only to know what he requires, when he can in simple cases obtain the result in the same form as on paper—length, breadth, thickness, contents. As this question involves two operations, we must prepare the rule by turning the upper slide so as to bring the line of square roots under the line of lengths; then referring to the question as previously stated $\frac{30 \times 144}{120} = x$ (in inches in the area of the pipe), that $\frac{30}{120} = \frac{x}{144}$. Then by the lower slide place 30 over 120, then over 144 36. Thus 36in. is the area of the pump. The diameter of a circle equals the square root of the area divided by the square root of ·7854, that is—

$$\sqrt{\frac{36}{\cdot 7854}} = 6 \cdot 76.$$

Now place the line of square roots exactly under the upper line of lengths. Then place 1 on the lower slide over ·7854 in the lowest line, then over 36 on the lowest line is 45·57. As this is the square of the diameter in inches, its root found on the upper slide is 6·75, thus solving the question without the use of any gauge point—that is, by common arithmetic instead of by slide-rule arithmetic.—F. A. SHEPPARD.

[52166.]—**Engine Power.**—When the steam arrives at the cylinder, its pressure is about 40lb. per sq. in., about 10lb. having been lost through condensation, &c. Then when cut off at ⅔, horse-power = 24·6, when cut off at ½, horse-power = 28·2, and when cut off at ⅜, horse-power = 30·5. Try cutting off altogether: you will find you will economise coal wonderfully.—SABATA.

[52166.]—**Engine Power.**—Multiply area of piston (143·139in.) by average force of steam in pounds and by velocity of piston in feet per minute; divide this product by 33,000; $\frac{7}{10}$ths of this quotient equals the effective horse-power. If steam be shut off at any portion of the stroke, divide length of stroke by length of space into which the dense steam is admitted, and find the hyperbolic logarithm of quotient, to which add 1; the sum is ratio of gain.—C. T.

[52166.]—**Engine Power.**—I do not wonder at the remarks of "Firer" and "Gossan" about the steam being cut off altogether. What I had meant was, What power would it have when *not* cut off at all? Which, if I understand "Gossan" aright, is what is meant in his answer, to be the power of the engine when so working. "Firer" suggests that I should get some friend to indicate it for me. Could "Firer" or "Gossan" tell me how to go about to get it ready for an indicator, and what it would cost? The engine is a vertical high-pressure one, cylinder at the bottom.—C. C.

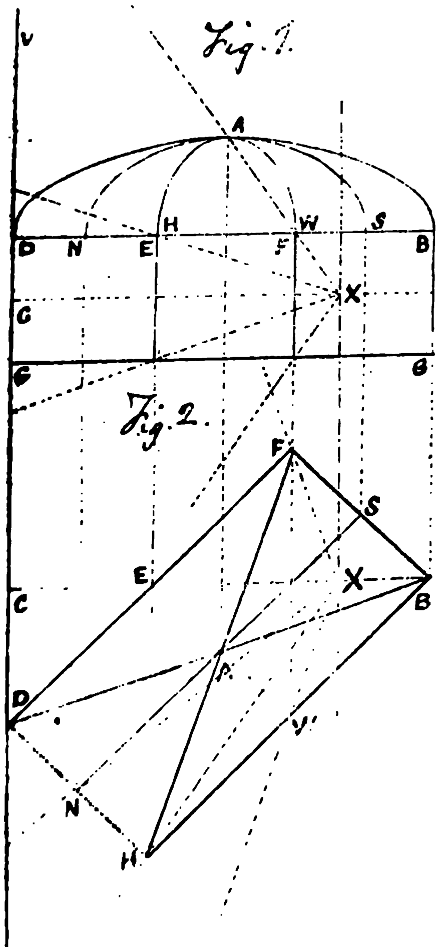
[52167.]—**Good Time.**—Will find a simple and efficient plan for taking and recording time in "ours," page 244, Vol. XXX. Should he desire any further information, I shall be happy to give it if he will advertise his address.—J. J.

[52168.]—**Royal National Tricycle.**—I regret to see an error in my reply to this inquiry. On the sketch it should be "lock" nuts, not "loose" nuts. Any practical hand will discover the error, though not all amateurs. The correction is due in fairness to the makers.—SECUNDUS HAUD ULLI.

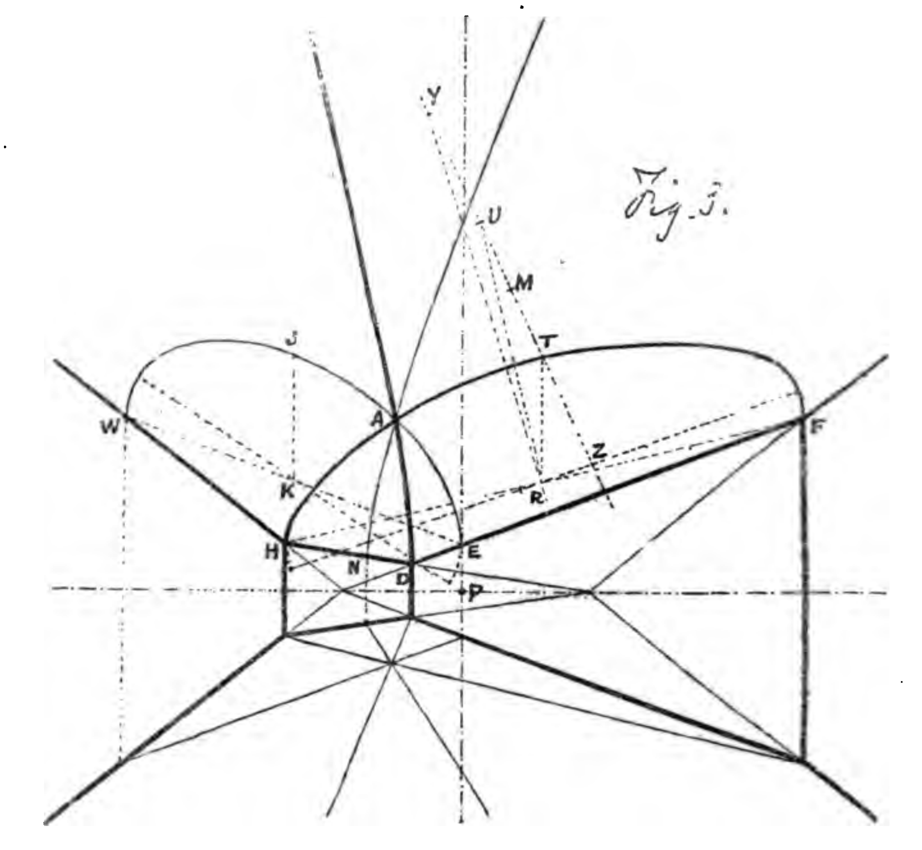
[52169.]—**Atomic Weights.**—There is an uncertainty as to the weights at present attached to some of the uncommon elements. Uranium is now generally given as 120, but cerium is given as 92 and 141·3 by the best authorities. "Experimenter" will find it necessary to bear this difference in mind until the question is definitely settled.—LABOR.

[52174.]—**Slide-Valve.**—"One who is Perplexed" is evidently not a practical engineer, and from the wording of this query I conclude that in the first instance the valve was not properly set, and in the second, that the valve face and the valve is not true, and as a consequence the steam blows right through; it makes little difference when he admits the steam to the valve chest, as the pressure of steam will keep the valve up to the face. "Perplexed" has not given the width of the ports and how much the valve overlaps them, so it is rather difficult to give him the cause of his difficulty without further particulars. I have had nearly 20 years' experience in the engineering, with stationary and marine engines, but more particularly the marine, both in the merchant service and the Government, and will give "Perplexed" a few little hints which perhaps may be of service not only to him but to other readers of the ENGLISH MECHANIC. The slide-valve (as I believe Mr. Burgh justly observes) is to the steam-engine just as the heart is to the human body. I never gave that attention to the slide-valve until I was engaged in a large engineering works in the North of England, in the experimental department. My duty was to test oils, gas burners, the action of oils on indiarubber valves, and a hundred and one different subjects which would come under the notice of the management of a large works employing over 3,000 hands. During the time I was in their service I constructed a skeleton model, and that is just what "Perplexed" should do: he will then see the action of the valve. This model to which I refer was made in order to demonstrate the action of certain improvements contemplated in the link motion, and I can say that I learnt more from this experiment than I had before from either reading books on the subject or from drawings. It is a subject, the slide-valve, that to go fully into would occupy many pages of our valuable journal; but with your kind permission I will give you a sketch how to construct a skeleton model, as I am sure it will interest many, and show many curious features which would perhaps pass unnoticed to those only partly acquainted with the action of the slide-valve. Now, to the practical, I always like to see the slide-valve overrun the valve face; for when it is not so, the valve wears itself down just where it is in motion, and the end of the stroke forms a nasty ridge, that when you adjust your valve the valve must leak. Speaking of leaking valves, it was formerly the practice of engineers to file and scrape up the valves and faces. In the States (U.S.A.) that practice is nearly abolished, as it has been found in practice to be a waste of time. It stands with reason, if it is properly looked to, that such is the case. Now if a valve was a piece of iron, and was one equal thickness, then under all moderate changes of temperature it would maintain its form; but it is not so, as it has been proved in practice that a valve scraped to a perfectly true surface at a temperature, say, of 60deg., was perfectly tight under hydraulic pressure at that temperature, yet leaked under 60lb. steam. How is this? Well, simply because the valve is of unequal thickness in different parts, and this unequal thickness causes unequal expansion, that although tight at, say, [illegible]deg., its shape is so altered that it leaks at [illegible]deg. I have seen many valves taken out after trial trips that had never been touched either by the file or scraped, but had just been put in as they had left the planing machine, and after a few hours' run brought themselves up to a fine face, especially the high-pressure one; in the low-pressure one the case is different, as the pressure is not so great, and, of course, the temperature is not so high, consequently the alteration of the form of the valve is not so great by the unequal expansion. If "Perplexed" gives further particulars, I shall be happy to assist him, either through the medium of our valuable paper or personally, if he will advertise his address.—INGENIERO.

[52175.]—**Perspective of an Interior.**—As "Murano's" case is interesting, and as it is impossible to answer the query without diagrams of a somewhat complex nature, I trust the Editor will consider it worth while to engrave them. My methods can be demonstrated to be mathematically accurate. "Murano" does not give all the requisite conditions of the problem, but I have arbitrarily fixed upon such as were wanting. I have arranged matters so as to have the point of sight P (Fig. 3) in the picture in a middle vertical line, where it ought always to be. I derive the perspective from orthographic projections in a manner which is applicable to every possible case. Fig. 1 is the elevation, and Fig. 2 the plan, the latter being first drawn, and the former made to agree or square with it. The parallelogram, D F B H, is the plan of the hall, B being the S W corner, at which "Murano" says the spectator is to stand. As, however, he is to be 5ft. from the S. and W. walls, I have put him at X, of course within the hall. I assume a vertical plane, C B, to pass through the angle B, and through the viewing station X, and I assume the plane of the picture to be vertical, and at right angles to C B. The distance of the plane of the picture from the station X does not matter—the greater the distance the greater the scale of the perspective drawing, that is all—I have, therefore, for convenience, assumed the vertical line, V L, to represent the plane of the picture in Figs. 1 and 2.



In Fig. 2 the lines D B and F H represent the diagonal lines of the ceiling, and I have added lines, N S and E W, representing middle longitudinal and transverse sections of the ceiling for further illustration. In Fig. 1, G G is the ground line, G X is the height of the viewing station X, and D B the top of the walls, whilst A is the apex or top of the ceiling at the middle. The semi-ellipse, D A B, in Fig. 1, corresponds to the line D B in Fig. 2, and the semi-ellipse, E A W, corresponds to both E W and H F in Fig. 2, whilst N A S corresponds to N S. From X, in each of the Figs. 1 2, draw lines through every necessary point of the elevation and plan, so as to cut the picture line V L. These lines, only a few of which are shown, and in a dotted form, mark on the line, V L, distances from the centres C C, to be used for obtaining the perspective picture Fig. 3, the distances got by means of Fig. 1 being vertical distances (or ordinates), and those of Fig. 2 being horizontal distances. I must here remark that the distances actually used for Fig. 3 are considerably reduced in scale from those on the line V L, Figs. 1 2, in order to get Fig. 3 of a convenient size. In Fig. 3, horizontal and vertical lines are drawn through the point of sight P, and the distances obtained from Figs. 1, 2 are set off from that point. Then the perspective points are obtained as intersections of vertical and horizontal lines drawn respectively through the points set off on the horizontal and vertical lines through P. There is, of course, no difficulty about the straight lines; but the curved lines of the roof require special treatment. Now, any line which is a circle or ellipse in the object, and entirely in front of, and not touching, the station plane—that is, a plane parallel to the picture plane and passing through the station X—will be represented in the perspective by a circle or ellipse. The line E W in Fig. 2 represents a semi-circle, which is represented by a semi-ellipse in Fig. 3 and the line F H in Fig. 2 represents a semi-ellipse, which is represented by a semi-ellipse in Fig. 3, these both being in front of the station plane; but the lines D B and N S in Fig. 2 represent semi-ellipses, which cut the station plane, and which have to be represented in Fig. 3 by portions of hyperbolas. The perspective of a circle or ellipse touching the station plane would be a parabola. It is usual to obtain the perspectives of circles and other curves by finding points and drawing curves through by the eye; but in the present case it happens that the axes of the perspective ellipses can be very easily found, and that the curves can be drawn with much more accuracy than by means of points. Thus, if we take the ellipse H A F, the vertical lines at H and F are tangents to it, and are represented by parallel lines in the perspective. Then from the properties of ellipses, if the diameter H F is bisected in R, and a line R T be drawn parallel to the tangents at H and F—that is, vertically—R T will be a conjugate semi-diameter. By working back from Fig. 3 to Figs. 1 and 2, it is easy to find the perspective length R T, and then the major and minor axes of the ellipse can be found in the following manner: Draw R U equal and at right angles to R F: draw a line through U T, and bisect U T in M: and set off from M distances M Y, M Z, equal to M R: then the axes will pass through Y and Z respectively, whilst the minor semi-axis will be equal to Y U, and the major semi-axis will be equal to U Z, with which data the ellipse can easily be drawn. The line E W in Fig. 2 represents a semi-circle, and its perspective is the ellipse E J W in Fig. 3. The hyperbolas N A, &c., and D A, &c., are most conveniently obtained by means of points, as, although not difficult to find their axes, asymptotes, &c., it would be laborious and tedious to do so. In Fig. 3 I have shown much more than, with "Murano's" conditions, an artist would show in a picture; but I have done so to indicate the character of the lines the more clearly. The true point from which to view Fig. 3 is only seven-tenths of an inch in front of the point P; so that if the picture were drawn to a scale twenty times as large, the proper viewing point would even then be only 14in. off, and the portion included in a circle round P of about 30in. diameter would be as much as would be comfortably seen. The lines shown on the floor in Fig. 3 are perspectives of the lines D B, E W, F H, and S N, in Fig. 2, as projected down upon the floor, and are put in as likely to afford assistance to the artist in filling in details. As to the patterns spoken of by "Murano," even if it were more precisely described, the drawing of its perspective could scarcely be given, except upon a scale far too large for the pages of the "E. M."—E. H.



[52178.]—**Invisible Combustion.**—The experiment first described by "R. P." to illustrate invisible combustion is one of the many discoveries due to England's greatest chemist, Sir H. Davy, and was the result of an experiment with his safety-lamp in order to ascertain the limits of the combustibility of gaseous mixtures of coal-gas and air; indeed, invisible combustion is the explanation of the most remarkable features of the Davy safety-lamp. If the ordinary miner's Davy is supplied with a coil of platinum, fixed, and of the size as described by "R. P.", the platinum coil will remain incandescent after the light of the wick is extinguished as long as there is any hydrocarbon left in the lamp. This phenomenon is of intense importance to the miner, who, when in the dark and, by reason of firedamp, dangerous recesses of a coal mine, finds his lamp extinguished, but leaving the platinum coil incandescent, and giving light sufficient to permit his escape. If, instead of the wick and spirit of the lamp, a cylinder of camphor is substituted, the result will be the same, with the addition of the exhalation of highly odoriferous vapour. If oil of turpentine is used, invisible combustion ensues, unaccompanied with the incandescence of the platinum coil, but producing dense columns of vapour. By adding various fragrant aromas to the oil, sweet-scented odoriferous vapours will be obtained. The instances of invisible combustion, as described by "R. D.," and those given above, are far more remarkable than that described by Mr. Fletcher, and known to Mr. Magloskie and others for years. I should be pleased to know from Mr. Fletcher if he has any analyses of the products of invisible gaseous combustion, as carried out by him, as these would show the economical advantages (if any) possessed by this method of combustion. In ordinary visible combustion the zone of hydro-oxidation is colourless; it is only the carbon atoms set free and incandescent which give the light until it is oxidised. In the action of invisible gaseous combustion, I believe the carbon is set free as carbon monoxide, and this has a reducing or deoxidising action on the incandescent coil of wire.—B. H. T., F.C.S.

[52184.]—**Altitudes.**—I have calculated these by a table of Sir George Shuckburgh, given in Drew's "Meteorology," where—

h and h' = barometer reading at upper and lower station,
t and t' = temperature of the air ditto,
T = tabular quantity opposite the mean of $t + t'$.
Formula—

$$\frac{30\,(h - h')\,\mathrm{T}}{\frac{h + h'}{2}} = x$$

$$(1) \qquad \frac{30 \times \cdot 536 \times 936 \cdot 0}{29 \cdot 874} = 503 \cdot 8 \text{ feet.}$$

$$(2) \qquad \frac{30 \times \cdot 531 \times 932 \cdot 0}{29 \cdot 844} = 497 \cdot 5 \text{ feet.}$$

I fancy the above is correct as well as simple.—LYMINGTON.

[52186.]—**Saturn.**—The brightest sat. is always Titan. The others are difficult to identify because of their changes of brilliancy, but are not of much consequence. Iapetus is sometimes bright at W. elongation. I have seen the crape ring crossing the planet with 2in., and in the Ansæ with 4½. Why not reduce objective until crape ring disappears? You would then know smallest aperture at which it is visible. Clockwork helps detection of details by keeping star in the field.—C. J. RYAN, Ventnor.

[52186.]—**Saturn.**—With regard to "Aziola's" question *re* the crape ring, back numbers may be consulted with profit. The Rev. T. W. Webb, in his delightful "Celestial Objects," remarks: "It has been well seen with a $3\frac{3}{8}$in. achromatic by Ross; I saw faint traces of it with my $3\frac{7}{10}$in.; anything larger, if good, is sure to bring it out." Proctor says somewhere, a 4in. aperture is necessary. Barnard (ENGLISH MECHANIC, Jan. 7, 1881), finds one crape ring "seen distinctly in moonlight" in the clear American skies. Yet another correspondent, armed with a 6in. Calver, complains (March 30, 1883), that he can never see the crape ring distinctly, though Encke's division is within his grasp. Surely in these and other cases eyesight and experience as well as aperture must be taken into account. I well remember, through the kindness of an accomplished contributor to these columns, gazing at Saturn through his noble 12in. Calver. His practised eye could detect crape ring, Encke's division, and all, whilst to my inexperienced eyesight not even Cassini's division was revealed.—ARTHUR MEE.

[52193.]—**Telescopic.**—I am greatly obliged to Mr. Franks for his kind and lucid reply to my query. Will wait, however, until I get a larger aperture before obtaining compound eyepieces.—ARTHUR MEE.

[52195.]—**Caoutchouc.**—Doctors can, and occasionally do, restore noses from flesh taken from the forehead or other part of the patient. These are very different from the indiarubber noses recommended by "Os."—W. G.

[52198.]—**Firing.**—If you wish to gain information about firing stationary engines I would recommend you to read "Stationary Engine Driving," by Michael Reynolds, published by Crosby Lockwood and Co., London, where you will find the subject fully treated of, and in a most practical manner. "Locomotive Engine Driving," by the same author, contains equally clear directions for firing locomotives in the best and most economical manner.—MACHINA.

[52199.]—**Ornamental Flower Pots.**—In my query on page 228, the word "dry" was omitted after "mould" in the fourth line, which is, I think, the reason I have not received any information.—M. W. S.

[52200.] — **Vacuum Gauges — Continuous Brakes.**—When the automatic vacuum brake was introduced upon the Midland Railway by Mr. Sanders, vacuum gauges were placed in the guards' vans; but these were afterwards removed by the railway company with a view to obtain fewer parts and greater simplicity, the result being that efficiency has been sacrificed. Major Marindin, when reporting upon the collision between a passenger train and the buffer-stops at Northampton, April 3rd, 1883, stated that it furnished "a strong argument for the necessity of placing gauges in the guards' vans, so that they may see at all times what is the condition of this continuous brake, which is particularly liable to become useless when running, in the event of a driver disregarding the rules." The directors, in accordance with this report, and also in consequence of several other cases, have ordered that vacuum gauges shall be placed in the vans without delay. These gauges are duplex, the left-hand side shows the vacuum maintained in the brake pipe, and the right-hand side indicates the vacuum in the reservoir and above the one piston placed under the van itself. Any person riding in a van cannot fail to remember the words of Colonel Rich, that the efficiency of this class of brake is materially interfered with by the leakage hole in the piston head, for the new gauges show, what I have so often pointed out, that the moment the brake is applied the power begins to leak away, and that it is all gone in less than two minutes.—CLEMENT E. STRETTON.

[52204.]—**Long Pendulum Clock-Case.**—If clock-case stands out from the wall, and on the floor, it would be difficult to say why it does not give out the sound of the bell if it is struck. Are you sure it is? The head of case ought to draw off; usually a button inside case, just under six o'clock, fastens it on, and is got at by opening the front door and passing the hand up inside. Get the head off, turn minute hand round to about one minute past the hour, or twelve; listen if clock strikes, if it does, then set minute hand about one minute before the hour (and have the clock going), put head on again, listen if you can hear it strike (by putting your ear close to the case, which you will, if you can hear the clock tick); should you hear the striking but faintly, I would advise you to have the sides of clock-case head cut out, and fitted with silk and fretwork; the sound will then come out, I venture to say. If you cannot hear any striking when the head is on, but can when off, look to the hammer; it may catch some part of inside of head, or the bell may touch it.—X.

[52207.]—**Boring Cylinder.**—If your cylinder was $\frac{1}{16}$th higher from the bed at one end than at the other, then it would be impossible for the lines to show true with the bar when the cylinder was carried from end to end, as that part which is being cut is, as you say, always at the same place on the bed: therefore, when the high end comes to the cutters they will take out $\frac{1}{16}$th too much at the bottom, and leave the same amount too much at the top. When doing a job of this kind it is absolutely necessary that the job shall be parallel every way with the bed. It does not matter much about the bar. If it was 1in. higher one end than the other, it would still bore true with the bed. It is different when the job is fixed, and the boring head slides on the bar; then it does not matter how the job, or the bar, stands with the bed so long as the job is true to the bar. How did you try the lines to see that they were fair with the bar? Calliper from the bar, while standing, with a pair of "jennys," or try it with a V scribing block? Both of these ways being practically alike and bad; as if the bar is bent, it throws the job just that much out. The only right way is a tool, taking the place of a cutter, drawn to a point and bent to suit, so that you can turn the bar round, and thus check it as if it was actually cutting. Now, if you used a tool like this, and it showed all right at each end, your job would have been all right, whatever the scribing block showed. If the job was all right, the only way I can see to account for the scribing block showing wrong is that the bed is not flat across. It would be all right at the back poppet end; but close up to the headstock you will find old lathes worn all shapes, some rounding, some hollow. Now, if the foreman set the block at the unworn part of the bed, and then tried it at the worn part, and if that part was hollow, the point of the scriber would of course hang down, and show as if the job was high that end; and the further the scriber was out to reach the centre the worse it would be. You should have run the job along, so as to let him try from the same place in the bed, each end of the job. I have been for months on this class of work, and never used or heard of using a scribing block as a check, as it would only be a check vertically, even on an unworn bed; the work may be out any amount sideways, and it would not show it. You should have got them to let you run a cut through, and see if it showed parallel with the lines.—WESTON.

[52212.]—**Engineering School.**—There is a good school for training engineers held at the Crystal Palace, where a young man would get a good practical insight into all the branches of the profession; it is called The Crystal Palace Company's School of Practical Engineering; Principal, J. W. Wilson, M.I.C.E.—T. R. SAXTON.

[52211.]—**Electric Formula.**—The determination of the attraction between two coils is not such a simple thing as Mr. J. Crocker seems to imagine, nor is it capable of being expressed in an algebraical formula in the general case. If the coils are upon the same axis and parallel, and not very near each other—say, not less than five or six times their radius—the attraction is given approximately by the formula—

$$4\,\pi^2\,\mathrm{C}_1\,\mathrm{C}_2\,\frac{a_1^{\,2}\,a_2}{r^3}$$

Where C_1 C_2 are the currents in the coils (supposed simple), a_1 the radius of the larger, a_2 that of the smaller coil, and r the distance between their centres. If the coils are on square frames of side a, and situated in parallel planes with distance h between, the attraction is—

$$8\left(\frac{a^2}{h\sqrt{a^2 + h^2}} - \frac{a^2 h}{(a^2 + h^2)\sqrt{2a^2 + h^2}} + \frac{2h}{\sqrt{a^2 + h^2}} - \frac{h}{\sqrt{2a^2 + h}} - 1\right)$$

If Mr. Crocker is pretty well up in mathematics, I should recommend him to read "Electricity and Magnetism," by Mascart and Jubert, of which there is now an English translation. If he is not strong in mathematics, I should advise him to devote some time to them before doing practical electrical work.—NABLA.

[52217.]—**Bassoon.**—Some notes do not admit of a shake, others present difficulties, and the rest shake naturally and easily—all which information can best be gained by purchasing some instruction book. Jancourt's "Méthode pour le Basson" is a good one. It is published in two parts—Part I., Information; Part II., Examples of same. It costs, complete, 30s. The pitch is altered by having additional flat or sharp crooks. The reeds are softened by scraping away the thick part of the wood, about halfway between lip end and the first wire band. The cork is to make the tube air-tight. —F. D.

[52218.]—**Medical.**—Does "Assistant" feel the effects of a little pleurisy, with which congestion is often complicated? Similar effects in my own case the doctors spoke of as caused by pleuritic adhesions. Mustard or turpentine relieved me at the time; but though I only feel them occasionally now, I know they are there, and do not expect to get rid of them.—H. H.

[52218.] — **Medical.** — There are few trifling ailments the public are more uneasy about than pains in the chest walls. When unassociated with constitutional disturbance—e.g., fever, loss of appetite, malaise, &c.—they are generally due to intercostal neuralgia or intercostal rheumatism, and quickly relieved by the application of an adhesive plaster, of which perhaps belladonna is the best. —M.D.

[52218.]—**Medical.**—Assistant is evidently suffering from a little pleurisy of the right side. His means of cure are to get his system into good working order by means of plain dietary, fresh air, warm baths, and exercise. Fresh air he must get, if possible, as all lung complaints are due to want of that. For local application he can use friction with a rough towel, paint with tincture of iodine, apply mustard leaves (Rigollot's), or even a porous plaster of some kind. Deep breathing a few times a day is also a good plan, as it tends to prevent adhesion of the lung to the walls of the chest. "Assistant" must not be surprised if the pain lasts another month; but time and the above will cure it. —T. R. ALLINSON, L.R.C.P.

[52223.]—**Covering Sharp Edges of Steel.**—How would "japan" do? There is a variety that dries in a few minutes when the article is made warm. Any varnish dealer keeps it.—NUN. DOR.

[52227.]—**Vacuum Brakes, L.N.W.R.**—There is an automatic brake fixed on the middle pair of wheels on the brake vans; whilst running, the brake is kept out of gear by the driver maintaining a small vacuum. Should he fail to do this, or the train breaks loose, or the pipes disconnect, or a leakage, the brake goes on. The guard is apprised of this by the falling of a lever, which sets a bell ringing. The valve is for taking the brake off by letting in the air. There are gauges in the vans which let the guard know the amount of vacuum. I do not think it is the same as the L. and S.W.; it has been improved lately. The piston in the cylinder works with a crank instead of a ratchet wheel, and the coaches are provided with a lever to shut off the brake connection should it fail or run on a foreign line.—ROB ROY.

[52228.]—**Electro-Magnets.**—1: soften, yes; 2: horseshoe: 3: round; 4: no; 5: yes, no waste space.—C. WEST.

[52231.]—**Self-Closing Door.**—I bought at the ironmonger's a cheap contrivance which works well. Two leather straps are inclosed in a coil of strong wire, which is compressed by pulling opposite ends of straps. One end is fixed to the door itself on the inside a few inches from the hinge, and the other to the adjacent framework. A more perfect and powerful affair may be seen at work in almost any public office. Doors which close by a slant in the hinge-joints are for a private house as good as anything. "Chemicus" exclaims "No weights"; and I agree with him, having experimented, and narrowly escaped smashed toes.—ARTHUR MEE.

[52233.]—**Boiler Feed from Cistern.**—A head of water 10ft. high will feed boiler.—SABATA.

dimensions and say what kinds of wood should be used for different parts of 'cello, what thickness the pieces ought to be for back and front to allow for modelling, the knees of sides, &c.? Any information an amateur is likely to require to enable him to construct one without improvements will greatly oblige.—Edinburgh.

CHESS.

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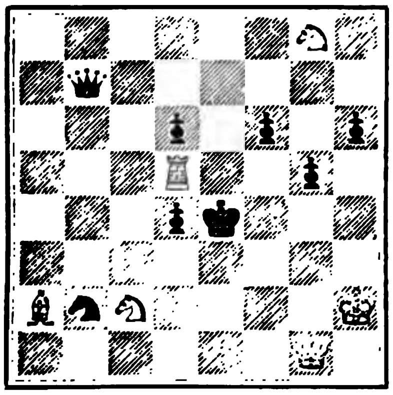
All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXII.—By R. Cat-rmann.

Black.



White. [6+8

White to play and mate in three moves.

Solution to 860.

White.	*Black.*
1. B–Q B 2 (dis ch)	1. Kt covers
2. Q B 5 (ch)	2. B covers
3. Q–K 3 (ch)	3. B covers
4. Q takes Kt (ch)	4. B covers
5. Q–K 7 (ch)	5 Q covers
6. Q·B 5 (ch)	6. Q covers
7. Q–K 3 (ch)	7. Q covers
8. B–Q sq	8. Q takes Q mates

NOTICES TO CORRESPONDENTS.

Correct Solutions to 860 by D. Mackay (an exceedingly pretty problem: only its motto helps you a good deal in solving it); to 859 by F. F. Bidlake and D. Mackay.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 21, and unacknowledged elsewhere:—

Hennan and Froude.—R. W. Thomas and Co.—J. and H. Grace. Britannia Co. W. F. Stanley.—Lucas and Son. J. W. Queen and Co. L. and H. W. M. Ingram.—F. Grant. M. Jones.—Miranda.—A Decided Amateur. Vulcanite.—A. S. I. W. F. T. A. Dring.—Wag. Soap Boiler. B. H. M. A. Light.—Ego.—C. K. M. T. T. Ouvrier. Y. Z. E. Owen.—Amateur. Second Mortgagee. William E. Dawson.—Bow. Incognita.—Eyesight. Semaphore. Churchwarden.

Compass. Maxton's "Engineering Drawing," Lockwood and Co., Stationers' Hall-court, E.C., 4s., would be a suitable book. You will also find a very valuable series of articles on the subject in Vol. XXXIII. pp. 444, 467, 495, 566; Vol. XXXIV. pp. 32, 57, 85, 180, 489, 586.)—Fitter. (There are a variety of electric alarms in back volumes. For a simple one, see p. 561, Vol. XXVIII.; or for general directions, p. [illegible], Vol. XXXV.)—Amateur. (Voicing organ pipes is the art of the organ builder, and an amateur cannot hope to acquire even tolerable proficiency without much labour. For directions in building, see the back volumes commencing with Vol. IX.; the latest series of papers was in Vol. XXXII. pp. 25, 127, 2[illegible]1, 317, [illegible]; Vol. XXXIII. pp. 27, [illegible], 177, [illegible], 322, 431, 5[illegible]4.)—[illegible]. (Use brass spring wire. As it is doubtful if you can get that out of London, draw the ordinary wire through a hole in a steel plate that is just too small to allow it to pass without using force. Thin one end, pass it through, and then taking a firm grip, pull.)—M'Lean. (No one can tell you without making an analysis. They are mostly salts which treated with a little size or gum to protect from the atmosphere, and some are mixed with [illegible].)—Dar[illegible]. (Such a salt is not known. There are platino-cyanides of alkalis.)—F. W[illegible]. (Dab them over with a ball of putty; that is the simplest. See answer to "Questor" last week.)—M. A. P. (Napier's "Manual of Dyeing," Griffin and Co., London. Recipes for feather dyeing in back volumes.)—Isaac. Nonsense. (In going into action water would be let into the tanks so as to sink the vessel as low as would be safe, and thus offer only a small target to the enemy's shot; but that takes time, and there is no dancing up and down as you describe. By means of powerful pumps, however, the tanks can be quickly cleared, when the full amount of freeboard is required.)—Talus. (Edison's phonograph was illustrated on p. 30, No. 675; directions for making one on p. 157, No. 683.)—Donald Warren. (The carbon telephone, No. 692, p. 381, and No. 853. Chalk cylinder receiver and induction balance in No. 730; Crossley's microphone, No. 755. See also many other back numbers.)—E. J. P. (Application should be made to those who publish such statements. You will find our reference to it on p. 17[illegible], a week earlier than the date of your reference. When a really "cheap" battery for use in lighting private houses is invented, we have no doubt we shall receive early intimation; at present, inventors take their "news" where it is received without question. If you look through your back numbers—No. 948, for instance, you will probably get an idea.)—H. H. B. (See p. 456, Vol. XXXIV. Answered many times.)—Mark Wicks. (We do not care to reproduce the article, and should think you are not precluded from giving the information as a letter. Please yourself, of course; but if you care to send, it shall appear.)—B. Hardcastle. (Please send.)—J. Sutcliffe. (Enough has been said already, we think.)—G. D. A. (The insurance company in which the building is insured would probably have something to say if communicated with; but, after all, not much can be done with a landlord who has no more respect for his property than yours has—this, of course, presuming that he is bound to do repairs, and that it is not you, who, having obtained possession at a low rent, are neglecting an implied understanding to repair.)—Young Wheelwright. (The executors do not sign the will; only the testator and the two witnesses. If you apprehend any unfairness, you should advise the testator to lodge the will with his solicitor, or at his banker's, or in the hands of some respectable disinterested person. With regard to the cart-yes. Some articles on carriage painting appeared in Vol. XIV. pp. 555, 606, 659, and Vol. XV. pp. 88, 168, 218. There is also an American book entitled "The Carriage Painter's Manual," by F. B. Gardner, published by S. R. Wells, 389, Broadway, New York, which you might possibly be able to obtain through Trübner and Co., of Ludgate-hill.)—T. J. Milner. (Is it not that the movable leg being held underneath, the upper one appears to rise when the under one is allowed to fall?)—Alfred James. (Better buy it; but you can make it by dissolving an ounce and a half of shellac and a quarter of an ounce of benzoin in half a pint of rectified wood naphtha. Crush the gums, mix in a bottle, and put into a warm (not hot) place.)—Beta. (You will find the reply wanted on p. 201, Vol. XXXV.)—S. Newbury. (If you were to get a catalogue from one of the makers advertising in our pages, both questions would be answered.)—Item. (A professional would tell you in a moment, or one of the dressers. We do not think there is anything really satisfactory but shaving.)—Co. Wexford. (You will find a good deal about it in back volumes. It is better to purchase it than to attempt its manufacture. Messrs. Ihlee and Horne, of Aldermanbury, E.C., can give you all information about it.)—Guilliaumes. (See the back page of the No. for Nov. 2. A handy little book is Ellerbeck's, published by Cussons and Co., Bold-street, Liverpool; but you will find several on the shelves of any large bookseller.)—York W. R. (Both questions are answered on p. 241 of the same volume. The focus should be 6in. or less; the burner a Silber or any good device capable of consuming paraffin oil.)—F. C. Marshall. (The query is in too general terms. You can get an idea from many illustrations in back volumes, and then if any difficult point arises, ask a question about it. See p. 267, No. 922; also Nos. 530, 512, 574, 621, 695.)—James H. Halley Broomhall. (We gave a paragraph about it on p. 36, extracted from a notice in the *Times*. We are not aware that any expert has been invited to test the wonderful machine.)—Enquirer. (See p. 22, Vol. XII.; also pp. 454, 476, 501, Vol. XXXII. Any of the usual enamels or glazes will do; but the art of firing cannot be learned except by practical experience.)—J. M. (We have repeatedly pointed out that as a rule varnishes of all kinds are to be bought as cheaply as they can be made. However, dissolve half an ounce of genuine asphaltum in one ounce of Canada balsam and 10 ounces of oil of turpentine. If you cannot procure these articles of the best quality your varnish will be inferior to that sold by the dealers in photographic requisites, and if you do obtain them of good quality, they will probably cost more than the varnish ready prepared.)—Holcombe. (It is an advantage to have the dies hot; but they should be wetted too. If very large, wet thoroughly, and then pour on the wax, as if casting from a mould. By "wet" is to be understood damp all over.)—J. T. S., Southport. (Add water, and if they do not act they need taking to pieces. You will find full directions in back volumes.)—Edward Cosby. (Yes, that is it. Christmas-day is midsummer in the antipodes.)—C. (You forget that in the bottle experiment there is nothing but the original gases; in the cave there is probably a constant supply of carbonic acid from the bottom, while the mixture is swept out from the top by every breath of wind. The gases diffuse just the same, but the upper strata, say, in the wel[illegible] pumped up by the wind, and fresh air takes t[illegible] place, or, at least, mingles with them. It is only [illegible] closed, or practically closed, vessels that the gase[illegible] uniformly mixed. See any work on "Phys[illegible] under heads Endosmose, Diffusion, and Mixture [illegible] Gases.)—Pythius. (Perhaps the sal-ammoniac requ[illegible] more water. You can get suitable mangane[illegible] dealers advertising in our columns.)—Edith Wal[illegible] (Do you not think it would be advisable to procu[illegible] handbook of the art, if you intend making a bus[illegible] of it? If you do so, and become acquainted with [illegible] the rudiments, we have no doubt our readers will [illegible] you out of any difficulties; but it is too much to [illegible] for the elements. Will not the papers in the [illegible] volume help you?)—St. Mungo. (We think you [illegible] find what you meant on p. 520, No. 749. It is ma[illegible] a shellac varnish.)—J. M. Jones. (You do not w[illegible] a "book" for that. You will find several method[illegible] back volumes. See p. 467, No. 852. The usual [illegible] is to burn and fuse with carbonate of soda.)—C[illegible] Chem. S.S. (Why trouble yourself to calculate the[illegible] when you can buy a book of almost any second-[illegible] dealer. We cannot afford space to tell you h[illegible] "make" them; but you will find the method[illegible] described in most cyclopædias.)—X. Y. Z. (We do [illegible] know of any. You would find a great deal about t[illegible] engines in the technical journals, and about the sh[illegible] in the *Transactions* of the Institution of Naval Arc[illegible] tects; but you do not indicate the nature of the info[illegible] mation needed.)—Donald Crottach. (Queries ar[illegible] the class known as advertisements, because the repli[illegible] would necessarily advertise some firm. Try some [illegible] the artists' colourmen.)—Ebor. (Not of sufficient in[illegible] terest. We should hunt up the photographic stores i[illegible] any of the large towns.)—Dumo. (It is entirely a loca[illegible] question, and one probably which would have to b[illegible] argued, before a satisfactory decision could be obtained [illegible] and we really cannot spare half a column for the quer[illegible] and extracts.)—Edward M. Richards. (Too theolo[illegible] gical; there is no doubt the Canon was settled in som[illegible] way at that council.)—F. W. B. (Not illegal in smal[illegible] quantities, and for own use.)—J. C. H., R. A. [illegible] Bennett. (In type.)

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Messrs. James W. Queen and Co., of 924, Chestnut-street, Phi[illegible] delphia, are authorised to receive subscriptions for the Uni[illegible] States for the ENGLISH MECHANIC, at the rate of 3 do[illegible] 25c. gold, or Thirteen Shillings per annum, post-free. The cop[illegible] will be forwarded direct by mail from the publishing office [illegible] London. All subscriptions will commence with the number [illegible] issued after the receipt of the subscription. If back numbers [illegible] required to complete volumes, they must be paid for at the rate [illegible] 1d. each copy, to cover extra postage.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. P[illegible] free 2½d. each. Indexes to Vol. XI. and to subsequent vols. [illegible] each, or post free, 3½d. Cases for binding, 1s. 6d. each.

Throat Irritation and Cough.—Soreness a[illegible] dryness, tickling and irritation, inducing cough, and affecting [illegible] voice. For these symptoms use Epps's Glycerine Jujubes. [illegible] contact with the glands at the moment they are excited by [illegible] act of sucking, the Glycerine in these agreeable confect[illegible] becomes actively healing. Sold only in boxes 7½d., tins 1s. 1½d. labelled "James Epps and Co., Homœopathic Chemists, Lond[illegible] A letter received: "Gentlemen,—It may, perhaps, interest y[illegible] to know that, after an extended trial, I have found y[illegible] Glycerine Jujubes of considerable benefit (with or wi[illegible] medical treatment) in almost all forms of throat disease. Th[illegible] soften and clear the voice.—Yours faithfully, Gordon Hol[illegible] M.D., Senior Physician to the Municipal Throat and E[illegible] Infirmary."

Holloway's Pills have many competitors, [illegible] no equals, for supplying the young and delicate with a [illegible] strengthening, and purifying aperient. These Pills, composed [illegible] the finest balsams, are particularly adapted for all complai[illegible] peculiar to females, and are most serviceable at the criti[illegible] periods of early and mature years.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 30, 1883.

M. CAILLOT'S REST.

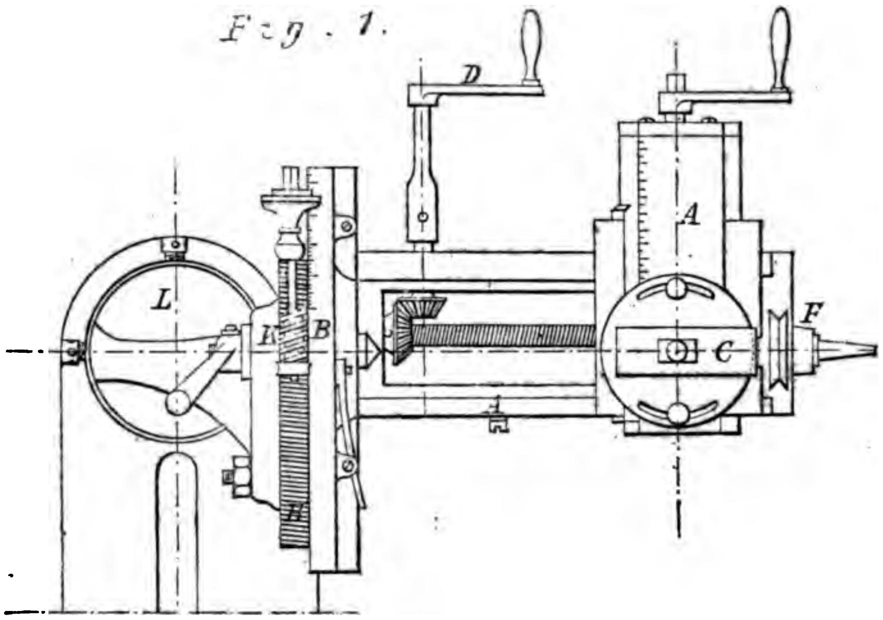


Fig. 1.

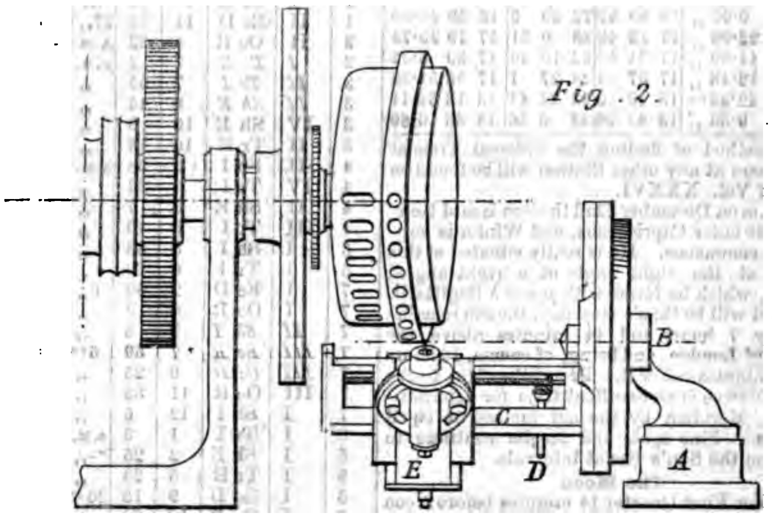


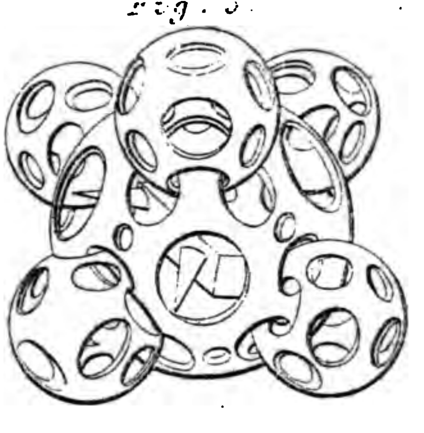
Fig. 2.

THE two figures annexed to this paper will, I think, be sufficient to show the general features of the rest suggested in M Caillot's pamphlet. The present form is an improvement on a more complicated design, originally devised by the inventor. It may be as well to state that the rest is not a mere theoretical arrangement, but is one in actual use, and proves equal to the work for which it is designed—viz., the placing ornamental drills and cutters in a proper position for the ornamentation of ellipses. Fig. 2, I think, will best illustrate the plan; but the elliptic chuck represented is not like that ordinarily used, and is probably one like that described by Bergeron. Into this, however, I need not enter. A, is a cast-iron support clamped to the lathe bed, and needs to be substantial, as it has to carry the whole slide-rest which pivots upon it. To my own mind, this is the weak point of the invention, as the rest is a heavy affair to overhang as it does here, with no support except at one end; but as the inventor is the better judge, and finds the arrangement a practically good one, I am scarcely justified in denouncing it. The rest is not pivoted direct to the support, as will be seen by referring to Fig. 1, which is a reduced drawing, quarter size. The plate B, which is circular, carries the rest attached to it by a slide moving in V's to allow it to be adjusted nearer to or further from the work. (There are two other drawings in the pamphlet showing the slide which I think will, however, be sufficiently understood without them.)

The front disc, to which the rest is thus clamped securely, turns upon a centre pin in a second circular plate, against the face of which it beds fairly. This back-plate is lettered H in Fig. 1. The plate H has a racked edge in which works the tangent screw which is fixed to the front plate, so that a circular motion is thus given to the plate carrying the rest; whereby the latter may be accurately placed at any desired angle, causing a tool in the holder to assume a radial position. As the rest is often so situated as to prevent the use of the ordinary handle to turn its leading screw, the latter is fitted with a bevel wheel to gear with one working at right angles to the screw, to which a handle may be applied when necessary. I have sent these drawings and brief description for the sake of the few who are in the habit of doing elliptic work, and who can judge of the merits of the invention better than I can myself. There are certain calculations necessary in order to determine the exact amount by which the worm wheel is to advance after each bead or device has been cut; but in order to explain these it would be necessary to copy some elaborate illustrations, and I think that if any one feels inclined to go into the matter, he had better procure a copy of the pamphlet. It is called "L'Art du Tourneur-Tabletier," and is published at Nantes by M. Th. Veloppe, à la Libraire Rue Jean-Jacques-Rousseau; and at Paris by M. Baudry, Libraire Polytechnique, 15, Rue des Saint Péres. The price, 2s. 6d.

The author invites correspondence, and indeed suggests the advisability of more intercourse between amateur turners. Possibly he would like to join the Amateur Mechanical Society. His address is 9 Rue Cambronne, Nantes. In the early pages of the pamphlet is such a specimen of interlaced ball turning as I never before saw, and full details are given for executing a similar one. M. Caillot has himself completed such a ball, which, as I cannot copy, I will describe. It consists of a hollow shell of ivory, inside which is a star of six rays, upon a cube cut out of the same solid as the ball. This, as any one knows who has tried it, is work enough for a man of ordinary patience and extraordinary skill; but this is not one half of the puzzle, for there are hanging about the big ball and linked into it six other similar shells, forming I think altogether the most marvellous specimen of a turner's skill ever executed. The ordinary Chinese balls are nowhere beside such a specimen as this. Of course tools and templets and plugs of various forms are needed, all of which were made as required, and, I may add, M. Caillot discovered for himself the way in which to cut out these balls from an inspection of one of the simpler ones in a turner's shop window. Even if the gentleman in question were a professional turner, the execution of such a work would have placed him in the front rank; but being engaged in business which leaves him little time for lathework, his skill is the more wonderful. If this ball were exhibited at the Mansion House this winter, it could hardly fail to bring due honour to the workman, and the introduction of a Foreign member would be a graceful act on the part of the Amateur Mechanical Society.

Fig. 3.



But if I were personally asked to attempt a similar piece of lathework, and had the requisite skill and appliances, neither of which I have, I should most certainly decline with thanks. It is the sort of job to be executed once in a lifetime as a guarantee of capability, and not to be repeated—a job for someone who has *too* much leisure, which I suppose is a disease not many of us are afflicted with. There were, I remember, some of these "boules agrafées" in Bergeron's volumes, very cleverly executed, but not as complicated as those now described. There was, however, one particular detail which I certainly have never seen in reality—viz., a sort of star with all its points or rays reversed—pointing inwards to a common centre. These, too, were the offspring of some Frenchman's skill—probably Bergeron's own; but I never read up the modus operandi, and verily it seems the nearest to an impossibility of any lathe puzzle. After all, though patience is not exactly a virtue of mine, I think I must set to work to copy M. [illegible]'s drawing. It will be an exercise at all events not without its own advantages. I only hope I may be fairly successful (Fig. 5), as I should like the readers of the ENGLISH MECHANIC to see what they can do over the water—not at Paris either, but at Nantes, where, by the bye, are some notable lathe makers. **O. J. L.**

ASTRONOMICAL NOTES FOR DECEMBER, 1883.

The Sun.

Day of Month.	Souths.			At Greenwich Mean Noon. Right Ascension.			Declination South.			Sidereal Time.		
	h.	m.	s. a.m.	h.	m.	s.	°	′	″	h.	m.	s.
1	11	49	5·49 ..	16	29	9	21	48	36	16	40	0·18
6	11	51	9·00 ..	16	50	52	22	30	3	16	59	42·96
11	11	53	22·?6 ..	17	12	48	23	0	31	17	19	25·75
16	11	55	44·3? ..	17	34	53	23	19	36	17	39	8·53
21	11	58	12·45 ..	17	57	4	23	27	1	17	58	51·32
26	0	0	42·55 p.m.	18	19	16	23	22	41	18	18	34·11
31	0	3	9·56 ..	18	41	26	23	6	30	18	38	16·89

The method of finding the Sidereal Time at Mean Noon at any other Station will be found on p. 573 of Vol. XXXVI.

At 4 a.m. on December 22nd the Sun is said technically to enter Capricornus, and Winter is supposed to commence. He is really situated at this instant at the right angle of a right-angled triangle, which he forms with μ and λ Sagittarii. The 22nd will be the shortest day, the sun remaining only 7 hours and 44 minutes above the horizon of London, and being, of course, 16 hours and 16 minutes below it. From the 21st to the 23rd inclusive is an excellent time for determining the Meridian by the old method of equal altitudes. Fine spots and faculæ continue to appear on the Sun's disc at intervals.

The Moon

Enters her First Quarter 14 minutes before Noon on December 7th, and is Full at 5h. 25·3m. a.m. on the 14th. She will enter her Last Quarter at [illegible] a.m. in the morning of the 21st, and be New at 59·7m. after Noon on the 29th.

Day of Month.	Moon's Age at Noon.	Souths.		
	Days.	h.	m.	
1	1·7	1	14·0	p.m.
6	6·7	5	19·2	,,
11	11·7	9	44·4	,,
16	16·7	1	46·2	a.m.
21	21·7	5	50·4	,,
26	26·7	9	31·7	,,
31	2·0	1	39·3	p.m.

The Moon will be in conjunction with Venus at 10 a.m. on the 1st; with Saturn at 1 a.m. on the 13th; with Jupiter at 3 a.m. on the 17th; with Mars at 2 p.m. on the 15th; with Mercury at 6 a.m. on the 31st; and with Venus at 8 o'clock the same evening.

Mercury

Is an Evening Star during the whole of December, but especially towards the middle of the month is as badly placed as he possibly can be for the observer owing to his very great South Declination. His angular diameter increases from 4·6″ on December 1st to 6·2″ on the 31st.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	16	49·9	23	23·2	0	0·9	p.m.
6	17	14·9	24	39·1	0	15·1	,,
11	17	49·4	25	22·3	0	29·9	,,
16	18	24·2	25	29·8	0	45·0	,,
21	18	56·5	24	59·7	0	59·8	,,
26	19	32·0	23	51·4	1	13·3	,,
31	20	2·1	22	8·6	1	23·6	,,

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle, from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
12	B.A.C. 1272	6	6 10 p.m.	Dark	50	9	6 47 p.m.	Bright	335	296
13	δ³ Tauri	5	2 36 a.m.	Dark	53	92	3 23 a.m.	Bright	310	351
13	m Tauri	5½	4 42 p.m.	Dark*	134	96	5 23 p.m.	Bright	240	200
14	119 Tauri	5½	3 55 a.m.	Bright	70	110	4 52 a.m.	Dark*	280	322
14	120 Tauri	6	4 30 ,,	Bright	65	105	5 24 ,,	Dark*	285	326
15	26 Geminorum	5½	7 10 ,,	Bright	105	145	7 57 ,,	Dark	235	272
15	λ Geminorum	3½	7 20 p.m.	Bright	76	37	8 14 p.m.	Dark	277	236
16	68 Geminorum	5½	3 13 a.m.	Bright	42	63	4 13 a.m.	Dark	288	319
18	ω Leonis	6	5 23 ,,	Bright	65	87	6 35 ,,	Dark	250	282
18	16 Sextantis	6	11 6 p.m.	Bright	84	45	12 8 p.m.	Dark	241	204
22	28 Virginis	6	†7 19 a.m.	S.S.W.	334	343				

† A near approach. * But seemingly bright.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Tr E	1	35	A.M.	11	II	Tr E	1	9	A.M.	23	I	Ec D	1	5	22 A.M.
1	I	Oc R	10	45	P.M.	11	III	Sh I	6	36	,,	23	I	Oc R	4	3	,,
1	II	Ec D	11	32	27,,	12	IV	Ec D	3	39	58,,	23	*II*	*Ec D*	7	20	57,,
2	II	Oc R	4	32	A.M.	12	*IV*	*Ec R*	7	44	17,,	23	I	Sh I	10	22	P.M.
2	*I*	*Tr E*	8	2	P.M.	12	*II*	*Oc R*	8	5	P.M.	23	I	Tr I	11	1	,,
3	*II*	*Tr I*	7	55	,,	13	*I*	*Sh I*	7	31	A.M.	23	I	Sh E	12	42	,,
3	*II*	*Sh E*	8	45	,,	14	I	Ec D	4	43	28,,	24	I	Tr E	1	21	A.M.
3	IV	Sh E	10	6	,,	14	*I*	*Oc R*	7	51	,,	24	I	Ec D	7	38	44 P.M.
3	II	Tr E	10	49	,,	14	III	Ec D	8	36	24 P.M.	24	I	Oc R	10	29	,,
4	III	Sh I	2	38	A.M.	15	I	Sh I	2	0	A.M.	25	II	Sh I	1	33	A.M.
4	IV	Tr I	3	22	,,	15	I	Tr I	2	50	,,	25	II	Tr I	2	49	,,
4	III	Sh E	6	7	,,	15	III	Oc R	3	27	,,	25	II	Sh E	4	27	,,
4	III	Tr I	6	40	,,	15	I	Sh E	4	20	,,	25	II	Tr E	5	44	,,
6	I	Sh I	5	38	,,	15	I	Tr E	5	10	,,	25	*I*	*Sh E*	7	10	P.M.
6	I	Tr I	6	36	,,	15	I	Ec D	11	11	50 P.M.	25	I	Tr E	7	47	,,
7	I	Ec D	2	50	6,,	16	I	Oc R	2	18	A.M.	25	III	Tr E	8	35	,,
7	I	Oc R	6	5	,,	16	II	Ec D	4	44	48,,	26	II	Ec D	8	39	24,,
7	*II*	*Sh I*	7	8	,,	16	I	Sh I	8	28	P.M.	26	II	Oc R	12	43	,,
7	*III*	*Ec R*	7	59	6 P.M.	16	I	Tr I	9	16	,,	28	*II*	*Tr E*	6	51	,,
7	*III*	*Oc D*	8	23	,,	16	I	Sh E	10	48	,,	28	IV	Ec D	9	40	21,,
7	III	Oc R	11	58	,,	16	I	Tr E	11	36	,,	29	IV	Ec R	1	49	58 A.M.
7	I	Sh I	12	6	,,	17	I	Oc R	8	44	,,	29	IV	Oc D	2	39	,,
8	I	Tr I	1	3	A.M.	17	II	Sh I	11	0	,,	29	III	Ec D	4	32	52,,
8	I	Sh E	2	26	,,	17	II	Tr I	12	33	,,	29	I	Sh I	5	48	,,
8	I	Tr E	3	23	,,	18	II	Sh E	1	53	A.M.	29	I	Tr I	6	20	,,
8	I	Ec D	9	18	26 P.M.	18	II	Tr E	3	27	,,	29	IV	Oc R	7	10	,,
8	I	Oc R	12	32	,,	19	II	Oc R	10	25	P.M.	29	*I*	*Sh E*	8	7	,,
9	II	Ec D	2	8	39 A.M.	20	IV	Tr E	11	5	,,	30	I	Ec D	2	59	,,
9	II	Oc R	6	55	,,	21	I	Ec D	6	36	58 A.M.	30	I	Oc R	5	47	,,
9	*I*	*Tr I*	7	30	P.M.	21	III	Ec D	12	34	48 P.M.	30	I	Sh I	12	16	P.M.
9	I	Sh E	8	54	,,	22	I	Sh I	3	54	A.M.	30	I	Tr I	12	46	,,
9	I	Tr E	9	50	,,	22	I	Tr I	4	35	,,	31	I	Sh E	2	36	A.M.
10	II	Sh I	8	25	,,	22	I	Sh E	6	13	,,	31	I	Tr E	3	6	,,
10	II	Tr I	10	15	,,	22	III	Oc R	6	51	,,	31	I	Ec D	9	27	25 P.M.
10	II	Sh E	11	19	,,	22	I	Tr E	6	55	,,	31	I	Oc R	12	13	,,

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Mercury.

From this it will be seen that Mercury will start from the South Western extremity of Ophiuchus, cross the whole width of Sagittarius, and be found by the end of the month in Capricornus. He will not approach any conspicuous Star.

Jupiter

Still Souths after midnight, but is visible for the observer's purpose during the greater part of the night. His angular diameter increases steadily from 39·7″ on December 1st to 42·5″ by the 31st, and he is now the most brilliant and conspicuous object in the night sky.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	8	27·3	19	34·4	3	48·7	a.m.
6	8	26·5	19	38·3	3	28·2	,,
11	8	25·4	19	43·2	3	7·4	,,
16	8	23·9	19	49·1	2	46·3	,,
21	8	22·2	19	56·0	2	24·9	,,
26	8	20·1	20	3·6	2	3·2	,,
31	8	17·9	20	11·9	1	41·3	,,

Jupiter hence describes a short retrograde arc in Cancer.

Venus

Is an Evening Star, too, but is, practically, as badly placed for the observer as Mercury, and for the same reason. Her angular diameter increases from 10·4″ at the beginning of the month to 11·2″ by the end of it. She has now lost her perfectly circular outline, too, and is beginning to be gibbous.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	17	47·2	24	20·0	1	7·0	p.m.
6	18	14·7	24	29·9	1	14·7	,,
11	18	42·1	24	20·9	1	22·5	,,
16	19	9·4	23	53·1	1	30·1	,,
21	19	36·5	23	7·1	1	37·4	,,
26	20	3·1	22	3·7	1	44·3	,,
31	20	29·3	20	43·9	1	50·7	,,

The path indicated by the above Ephemeris begins in Sagittarius, extends, as in the case of that of Mercury, right across that constellation, and also terminates in Capricornus.

Mars,

Viewed with reference to his time of Southing, is still a Morning Star; but as he rises soon after 9 p.m. at the beginning of December, and at about 7h. 20m. in the evening at the end of it, he may now be fairly observed during all the later working hours of the night. His angular diameter increases from 11·3″ on the 1st of the month to 14·5″ by the 31st. Even with the latter angular subtense, though, he presents but a relatively small disc; and the student will note that he is still gibbous.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 29·3	17 28·2	4 50·4 a.m.
6	9 33·9	17 17·7	4 35·4 ,,
11	9 37·5	17 12·1	4 19·3 ,,
16	9 40·1	17 12·0	4 2·3 ,,
21	9 41·6	17 17·9	3 44·1 ,,
26	9 41·7	17 30·1	3 24·5 ,,
31	9 40·6	17 48·8	3 3·8 ,,

The arc thus described by Mars lies in that very blank region of the sky to the West of the Constellation Leo.

Saturn

Is visible all night long, and is excellently placed for the observer. His angular diameter decreases insensibly from 18·4″ at the beginning of December to 18·0″ by the end of it. No difference in the opening of his ring system is now perceptible.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	4 19·7	19 24·8	11 37·8 p.m.
6	4 18·0	19 21·2	11 16·4 ,,
11	4 16·3	19 17·7	10 55·1 ,,
16	4 14·7	19 14·4	10 33·8 ,,
21	4 13·2	19 11·4	10 12·7 ,,
26	4 11·8	19 8·7	9 51·6 ,,
31	4 10·5	19 6·3	9 30·6 ,,

So that Saturn will travel in a westerly direction from ε Tauri, the most northerly star in the Hyades.

Uranus

Will be in quadrature with the Sun at 7 a.m. on the 20th, but does not yet rise soon enough to be observed with any advantage.

Neptune,

Though, is visible during the entire night, and is in a very good position for observation by the possessor of adequate optical means.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 8·8	15 46·3	10 27·0 p.m.
6	3 8·3	15 44·4	10 6·9 ,,
11	3 7·8	15 42·6	9 46·7 ,,
16	3 7·3	15 40·9	9 26·7 ,,
21	3 6·9	15 39·4	9 6·6 ,,
26	3 6·5	15 38·1	8 46·5 ,,
31	3 6·2	15 37·0	8 26·5 ,,

From this Ephemeris it will be noted that Neptune travels into a position almost south of δ Arietis and some 3° or 4° from that Star.

Shooting Stars

Are less numerous than they were last month. The most probable periods at which their apparition may be expected are from the 11th to the 13th, and again on the 24th.

The Pons-Brooks Comet.

The Comet originally discovered by Pons on July 20, 1812, and detected on its return on Sept. 2nd of the present year by Brooks in the United States ("Scientific News," p. 35), is now nightly becoming more visible with but small optical aid. In fact, it may now be seen with a good opera-glass. We append the approximate co-ordinates of its position for every fifth day at Greenwich Mean Midnight, whence it will be found without difficulty.

Day of Month.	Right Ascension.	Declination North.
	h. m. s.	° ′
1	18 35 51	46 25·0
6	18 59 16	44 46·9
11	19 25 47	42 41·5
16	19 55 29	39 48·3
21	20 28 9	35 57·8
26	21 3 4	30 39·6
31	21 39 4	23 54·9

It will be seen from the above Ephemeris that the Comet will start from a point in that empty region some 8° North of Vega, and will travel in a South Easterly direction across the Northern half of Lyra, passing into Cygnus between the nights of the 9th and 10th. During the rest of December it will be travelling through that great constellation; and after the 11th, will be superposed on part of the Milky way; a very remarkable and unusual spectacle.

Greenwich Mean Time of Southing of Sixteen of the Principal Fixed Stars on the Night of December 1st, 1883.

Star.	Souths. h. m. s.
α Aquarii	5 18 56·83 p.m.
Fomalhaut	6 10 13·23 ,,
Markab	6 17 57·12 ,,
δ Sculptoris	7 1 43·78 ,,
α Andromedæ	7 21 11·92 ,,
α Cassiopeiæ	7 52 40·12 ,,
Polaris	8 35 39·00 ,,
α Arietis	9 19 7·60 ,,
α Ceti	10 14 33·24 ,,
α Persei	10 34 20·96 ,,
γ¹ Eridani	11 10 48·07 ,,
Aldebaran	11 47 21·23 ,,
Capella	12 26 6·89 ,,
Rigel	12 26 56·43 ,,
α Leporis	12 45 32·48 ,,
α Columbæ	12 53 21·46 ,,

The Method of determining the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in December, as also that of determining the Local Instant of its Transit over the Meridian at any other Station, will be found on p. 375 of Vol. XXXVI. The rules given, however (loc. cit.), are not rigidly accurate when applied to Polaris or to any close circumpolar star.

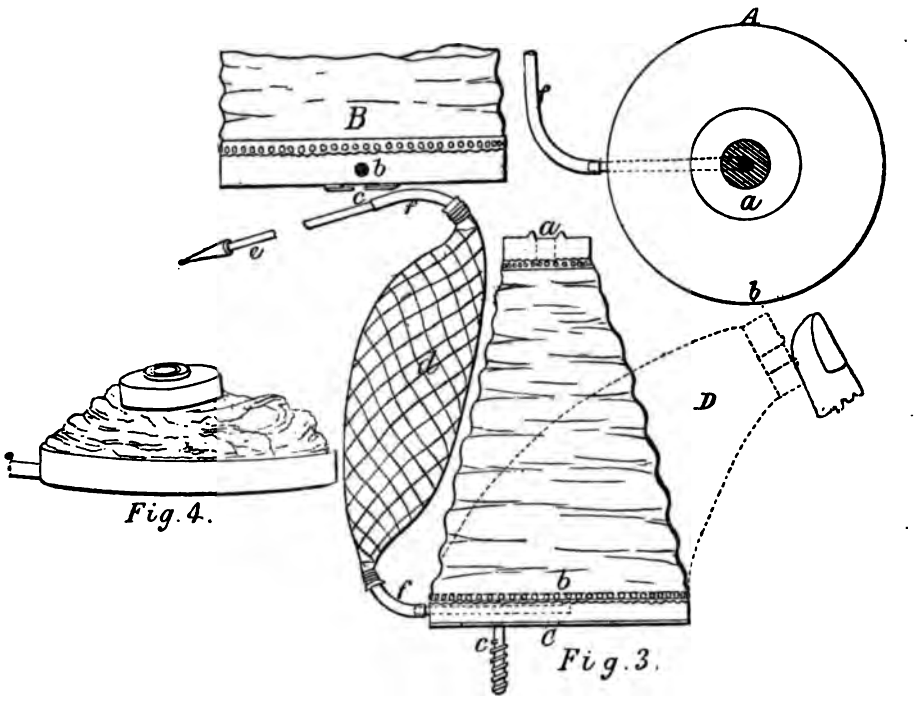


Fig. 4.

Fig. 3.

A NEW PATTERN HAND-BLOWER FOR BLOWPIPE ANALYSIS, WITHOUT VALVE OR SPRING.

By Lieut.-Col. W. A. Ross, F.G.S., late R.A.,
Member of the German Chemical Society.

A IS a plan of the two wooden circular frames belonging to this blower, *a* being the smaller frame, and *b* the larger one; the larger shaded circle is a hole cut in the upper smaller frame; the small shaded circle, a hole in the under larger frame. B is a front elevation of *b*, showing a section of the windpipe as a dark-shaded circle, with an iron slot *c* underneath, for the head of a screw or nail fastened into the table, to keep the blower down when pulled upwards. C is a stereographic sketch of the hand-blower in position, *a* and *b* being the two wooden frames, with *d* an elastic air-reservoir covered by a hair-net, and *e* a blast-pipe with nozzle, which can, of course, be made any length convenient to the operator; *c* is the table screw fitted into the slot above described, which Mr. J. T. Letcher thinks might be done away with, by weighting the inner side of the large wooden frame A with two pieces of lead: or the whole of its inner surface might be covered with a circular sheet of lead. This arrangement would not injure the table in any way, and would, I think, be sufficient to hold the blower down, making it a *little* heavier; but that is not of much consequence. *f*, *f*, *f* are pieces of elastic tubing, placed where convenient.

To use the machine, the smaller wooden frame is taken between the operator's thumb and second and third fingers; when the soft leather bag has been thus pulled out to the utmost extent, as shown in Fig. 3, the hole *a* is stopped air-tightly by the *first* finger, and the bag pressed firmly down, which motion has the effect of driving its contained air into the reservoir *d*, which is at once expanded, and exerts an amount of air-pressure upon the lamp-flame proportioned to its expansion. In pulling up the blower in order to renew the downwards stroke, of course the forefinger is raised from the hole *a*, thus acting as *the valve*, whilst the extremely slight muscular force of the arm required to pull up the soft leather bag, acts instead of the *steel spring*, which constitutes the chief expense of leather hand-blowers.

Mr. J. T. Letcher, of Truro, Cornwall, has been so kind as to make, at my request, a temporary but working specimen from the above sketch and description, of the cheapest possible materials; the air-reservoir and tube, *d*, *f*, Fig. 3, being made of one of those squeaking, elastic air-bladders sold in toyshops for one halfpenny each. He will, no doubt, make others more complete, and stronger than this, to any orders; and I am quite certain, from what I have seen of his work, the purchasers will be thoroughly satisfied with as being far more moderate in price, and [illegible] as well finished as that of the best Freiberg makers. I [illegible] constituted him sole trade maker of this [illegible] blower, which would appear to be the cheapest leather one in existence, as well as of the whole of my pyrological apparatus.

The dotted lines surrounding D show another form of wind-bag, which, I think, would be an improvement, and not increase the price at all. Fig. [illegible] is a rough sketch of the blower made by Mr. Letcher, closed for packing. All Figs. are half the natural size.

DR. MELDON'S ELECTRIC MOTOR.

AN improved electric motor has been devised by Dr. Austin Meldon, of 15, Merrion-square, Dublin, which not only does away with the manifold disadvantages and drawbacks attendant on the employment of dynamos, but also creates the largest amount of driving power with the least expenditure of electrical force. Dr. Meldon, in his first attempt at motor construction, made use of twelve magnets, but when the machine was tested it was found that although each of the magnets would lift half a cwt., or attract a heavy iron bar from 1in., yet the whole 12 when bound together would only lift or attract exactly the same weight. Seeing that something was evidently wrong, he sought information as to the cause of so singular a circumstance, but, although he received a very large number of suggestions, not one of his correspondents hit upon a solution. Nothing discouraged, Dr. Meldon persevered in his investigation, with the gratifying result that after some trouble he found that the inertness of the magnets was due to neutralisation, and that by magnetically insulating the bars with copper instead of iron bolts, and putting a few layers of guttapercha between the bars and the rims of the wheels, he could develop full power—a fact which seems to have been hitherto unknown. The armature of the new machine is formed by joining together two [illegible]in. solid pulley wheels with seven flat bars of iron, each bar being [illegible] long by 1in. wide and 1¼in. thick, and, as has been observed, the bars are laid upon guttapercha, copper bolts being used to fasten them to the wheels. A shaft of 1¼in. steel passes through the centre, and the whole is supported by a hard-wood frame, stayed with iron. Each side of the frame where the shaft emerges therefrom is supplied with an ivory commutator, the one on the right having three, and the other four, brushes, each of which communicates with a magnet. Attached to the frame are seven electro-magnets; the three larger ones being made of [illegible]in. soft iron, and wound with [illegible] wire without bobbins, and the other four of [illegible] iron, and wound with No. [illegible] wire. The total weight, as at present constructed, is a little over [illegible]. The first trial of the motor took place in [illegible] last, in a boat [illegible]ft. long and 5ft. beam; and the battery used on the occasion consisted of [illegible] cells of bichromate of calcium, with zincs [illegible] by [illegible]in. and carbons [illegible]in. by [illegible]in. Half of the current passed through a commutator into one set of magnets, the whole charge going into one magnet at a time, and the remainder of the current through the other commutator into the second set. The great utility of this arrangement was experienced during the trip, as when all the cells were made use of the boat went at full speed, but when only one commutator was employed half speed was obtained, and on a long trip the second battery could be [illegible] in reserve. The motor is capable of [illegible], but this is [illegible] was [illegible], when the boat [illegible] a little more than [illegible] [illegible]. It is [illegible] small size of the [illegible] battery, which was placed in the forward part of the boat [illegible] arranged [illegible] that there was only [illegible] with any degree of [illegible] was obliged to [illegible] with a battery [illegible].

[illegible] Dr. Meldon's [illegible] minutes, and it should be noted that the battery was nearly exhausted when this trial took place.

Dr. Meldon's object in consenting to the publication of these details of the motor is two-fold.—First, to place upon record an account of his original experiments for the benefit of those who are interested in the subject of electricity as a motive power: and, secondly, to receive any practical suggestions which the reader of this brief description of his invention may be disposed to send to him.

THE USE AND ABUSE OF THE MACKINTOSH.

THE season has set in for wearing mackintoshes. A caution may be therefore not unnecessary, and let us hope, not unheeded, as to the use and abuse of this serviceable, but, when improperly employed, dangerous, article of clothing. When once a mackintosh is put on to defend the body from wet, it should on no account be taken off until the wearer has not only taken shelter, but is in a position to change his clothes. What a covering of oiled skin does for a wet rag in the surgery—viz., convert it into a poultice—the mackintosh does for the clothes of its wearer. The insensible perspiration which finds a way of escape through ordinary clothing is kept in by the waterproof, and the clothes are saturated with moisture. A very few minutes will suffice to render the under-clothing "damp" under a mackintosh, particularly if either the wearer perspires freely, or the weather be what is called "muggy" as well as wet. When, therefore, the wearer of a mackintosh takes off that article of clothing because it has ceased to rain, he is in the position of a person who has damp clothes on, and if he sits in the saddle, or walks home, or rides in an open trap, he is more likely to take cold than if he had not used the mackintosh at all. If therefore, we say, a mackintosh is once put on, it should on no account be removed until the clothes can be changed or dried by a fire without reduction of bodily temperature. The use of a mackintosh is to protect a man from a severe storm of rain. His clothes *must* be damp if he wears one of these protectors. The sole gain from using it is to render the moisture warm instead of cold, and to prevent loss of heat by evaporation. If the mackintosh be removed, evaporation commences immediately, with all the consequent risks of that process.—*Lancet.*

USEFUL AND SCIENTIFIC NOTES.

Fluid of High Refractive and Dispersive Power.—Herr C. Rohrbach, of Leipsic, has lately described a method of procuring a fluid having extraordinarily high refractive and dispersive powers. 100 parts of iodide of barium are mixed with 130 parts of scarlet biniodide of mercury. About 20cc. of distilled water are added to the powders, and they are then stirred up with a glass rod while heated in a test tube plunged into an oil bath previously warmed to 150° or 200° C. A fluid double iodide of mercury and barium is formed, which is then poured into a shallow porcelain dish and evaporated down until it acquires a density so great that a crystal of epidote no longer sinks in it. When cold, even topaz will float in it. It is then filtered through glass-wool. The fluid so prepared has a density of 3·575—3·588, boils at about 145°, and is of a yellow colour. Its refractive index is 1·7755 for the C line, and 1·8265 for the E line of the spectrum. For the two D lines of sodium the refractive indices are 1·7931 and 1·7933 respectively. So great is the dispersion that, using a single hollow prism with a refracting power of 60°, the dispersion between the two D lines is almost exactly 2′ of angle.

Letts' Diaries.—First in the field, and certainly *primus inter pares*, are Letts, Son, and Co., of London-bridge, with their varied assortment of diaries for 1884. If only this firm had existed two centuries back, how many more finds like Evelyn and Pepys's diaries might posterity have had to rejoice over, such facilities do their numerous volumes furnish for every record with the slightest claim to preservation. Housekeeper and parson, business man and lawyer, man of fashion and fine lady, all alike are catered for, from the daintiest volume for the pocket to the rough scribbling diary for the desk, and all alike of the best.

Catalogues.—We have received the new catalogue and price list of the Anglo-American Brush Electric Light Corporation, which is a useful publication, showing the public what apparatus they can now have for arc and incandescence lighting, and the prices of the machines and accessories.—The "Amateur Catalogue" of Churchill and Co., [illegible]-street, Finsbury, is a reproduction, by the aid of photography, of their large catalogue of American machinery, &c., which we noticed on p. 12[illegible].

SCIENTIFIC SOCIETIES.

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ROYAL METEOROLOGICAL SOCIETY.

THE first meeting of the present session was held at the Institution of Civil Engineers, Mr. J. K. Laughton, M.A., F.R.A.S., President, in the chair.

The following papers were read:—

(1.) "Report on Temperatures in two different patterns of Stevenson Screens," by E. Mawley, F.R.Met.Soc. The screens employed were an ordinary Stevenson screen obtained from Casella, and a new Stevenson screen made in accordance with the recommendations of a Committee appointed by the Council of the Society. The new screen is 2in. wider and deeper than the old screen. It has also an upper sloping roof, and at a little distance below a flat inner roof pierced with holes for ventilation; while the old screen has a single flat roof with only a narrow slit beneath on each side for ventilation. Observations were made during the three months July to September, and the results are given in the paper. From these it appears that the new screen is, of the two, slightly cooler and better ventilated and retains the heat of the sun for a less time than the old screen; also, having a double roof and over-lapping boards below, it is better suited for extreme climates.

(2.) "On the Storm which crossed the British Islands between September 1st and 3rd, 1883, and its track over the North Atlantic," by C. Harding, F.R.Met.Soc., of the Meteorological Office. This storm caused considerable havoc in the south-west and south of England owing not only to its exceptional violence, but also to its occurrence before the completion of the harvest. The storm is traceable in the first instance to two centres of disturbance, one being first shown at about 450 miles to the south of Bermuda on the 26th of August, and the other to the east of the Rocky Mountains on the 27th; these two disturbances afterwards merged on the 29th at about 300 miles to the north of Bermuda and formed one great and destructive gale, which continued to grow in violence as it crossed the Atlantic until it reached the coasts of the British Islands. The average speed at which this storm crossed the Atlantic was fully 40 miles an hour, which is more than double the usual speed of storms which traverse that ocean.

(3.) "On the Influence of the Moon on the Height of the Barometer within the Tropics," by Robert Lawson, Inspector General of Hospitals.

(4.) "The Great Ice Storm of July 3rd, 1883, in North Lincolnshire," by J. Cordeaux. The direction of the storm was nearly south-east to north-west, and travelled from Caistor along the higher ridges of the hills to Barton-on-Humber. The storm commenced at about 9.20 p.m. with heavy drops of rain, increasing to a downpour, speedily followed, amidst the blaze of lightning and the constant roll of thunder, by the rush of hail, or rather lumps of ice. An eye-witness remarked that they were not like hailstones but "salt-cellars," another that they resembled "ducks' eggs"; in fact they were solid lumps of ice of every shape and size, weighing from 2oz. to 6oz., and some measured 6in. in circumference. The injury done to the growing crops cannot be estimated at less than £20,000.

Weights and Measures.—In a Board of Trade "Report of Proceedings under the Weights and Measures Act, 1878," just issued, Mr. H. J. Chaney remarks on his visit to the Paris Bureau, that "there can be no doubt that, in the construction and arrangement of the comparing rooms, and in the design and use of the comparing apparatus, the office at Sèvres has made important advances towards that high accuracy of work which science now demands. With the means there provided it is possible, for instance, to ascertain a difference between two kilogram weights so small as 0·0000003 kilog., or less than a three hundred millionth part of the whole weight. In the comparison of two metres, a difference so small as 0·1 micron (0·0001mm., or 0·0000039in.) could be determined. At the Standards Office, which is perhaps as well equipped as the best offices of other Governments, it is at present not possible, with the microscopic apparatus alone, to ascertain differences in kilogram weights smaller than 0·0000005 kilog., or the twenty millionth of the whole quantity weighed; or the difference between two measures of length to less than 0·000095in."

Temperance in Middlesex.—We have been asked more than once for addresses of societies and notes of coming events in connection with the temperance cause in the metropolis. Mr. F. A. Edwards, of 321, High Holborn, has sent us the first number of a quarterly record of Band of Hope and Temperance work in Middlesex, with a directory of societies and list of coming meetings. The price is only a penny, and the *Middlesex Temperance Chronicle* is well edited, and will be found very useful.

look exactly like small ink spots, the terminator being on the W. border of Stoffler. I have never seen them appear so again, even with the terminator so close as Landslaeg. I have seen Mr. Neison's parallel clefts between Cavendish *a* and *d*, but not those Mr. Gaudibert mentions crossing them N. and S. Some others I have seen, which are not shown by Mr. Neison. One joining Cavendish with Mersenius, starting N. of Cavendish A, and reaching Mersenius at a small crater which lies N. of the principal crater on the E. wall. It lies at the foot of some mountains which run parallel with it. Mr. Neison's cleft ψ reaches it about halfway along its course. Is there not a well-marked cleft crossing the entire length of Cavendish itself, from N. to S., which is not shown on the map? Crossing from east to west B and C casts of Cavendish, and an imperfect ring S. of C, I have seen light streaks which might, at another illumination, prove to be clefts. **M. A.**

SELENOGRAPHICAL.

[22073.]—Mr. Maitland Baird Gemmill makes some remarks on this subject, which show, as it appears to me, that he has a mistaken idea of selenographical work. It is not necessary, as he imagines, to possess all the works of the great Selenographers in order to do useful lunar work; some map is requisite, and Mr. Neison's alone would be sufficient. Then Mr. Gemmill complains that what is published is so technical; but this *must* be the case, and the same is true of any other branch of astronomy. If he means that it is too technical to be grasped easily, I think he is mistaken. He certainly has a mistaken idea of the use of the District Catalogues to which he refers. He seems to think that they and other things published can only be utilised by those learned in the science, and that "observers less ambitious or having smaller instruments, or less time, are not provided for; and that there is a want of readily accessible direction as to what should be done."

The catalogues can be used quite easily by beginners, and though they may look very technical on paper, they will be found to simplify lunar work considerably. All that is necessary is to obtain the key plan of the district, and then set to work with the list. It will be found a great help to have the leading known objects mapped and lettered, instead of being bewildered at the outset with the multitude of objects in a district, which must be mapped before anything can be done. A note appended to the catalogues asks for observations, therefore, I do not think anyone can complain of not knowing what to do. Catalogues are necessary as a foundation for work. Order and method there must be if anything is to be accomplished. Without some such lists, if several persons were to observe a formation, say only three, and each were to number the objects after his own private judgment, would not the confusion be great, and how could the necessary work of generalisation be done which Mr. Gemmill urges, and comparison of the observations in order to deduce results? Mr. Gemmill also laments the want of papers like some of those published in past days; but he forgets that if more observations of the moon were made, there would be more material for such papers.

I cannot answer Mr. Gemmill's question whether A in his sketch of Plato is a valley or cleft; but I have seen (1880) a valley or steep cliff in that position and extending some way northward. In 1878 I also saw two craters south of this spot, and three or four small ones north of it, with a projecting rock from one. B may be Schröter's χ, but if so, it seems to be too far east on the sketch. A line passing through χ and the east wall of Plato also touches two craters north of χ, one being on the edge of the white ground. The ridges B on his sketch, between Picard and Pierce, may be the same as that mentioned in "Lunar Work" in the "Astro. Register" for February, 1883.

With regard to lunar work generally, which seems to be alternately taken up and given up, if I may say my own idea, it is this: without intending to reflect on those who through circumstances have been unable to go on with it, I think what is needed is observers who will take it up and *stick to it*; not taking it up for a time and then tiring of it, but deliberating first and then doing it—for ever; remembering that as J. Ingelow teaches us:

"Here, as in other fields, the most he gleans
Who works, and *never* swerves." **M. A.**

TELESCOPE POWERS FOR JUPITER AND SATURN.

[22074.]—Amongst the readers of "ours" are possessors of telescopes of such almost infinite variety, that I think the point raised by Mr. Franks and "F.R.A.S.," concerning the relative powers that Jupiter and Saturn will bear, might be investigated, with a great probability of the reason of the apparent inconsistency being arrived at. If it is a fact that Saturn will bear *higher magnification than Jupiter, when the telescope used is practically free from imperfections, and the atmospheric conditions* are impartial, I am inclined to think that the reason will be found to be connected with the comparative definiteness of the details looked for in Saturn—the ring's shadows, and even the divisions in rings, being of a more uniform and decided character than anything to be seen on the average disc of Jupiter. The instruments I have at command are not of the necessary perfection to enable me to assist in the investigation; but I hope all of our astronomical friends who are in a position to do so will unite in the search for more light on a matter of interest to so many. **Makeshift.**

ADJUSTMENT OF REFLECTING TELESCOPES.

[22075.]—A correspondent writing upon this subject says, instead of making a dot in centre of his mirror, he uses a stop, just a little larger than his flat, so as to show a ring of light round the black shadow. This plan appears to me to require extreme care in placing the stop, as otherwise it would be sure to be wrong. As I remove my flat every time I use it, I have to adjust anew every time also; therefore, I have acquired much facility in adjustment. As there seems to me an unnecessary amount of trouble in nearly all the directions given, and my way is simplicity itself, I have ventured to describe it in the hope it may be useful to others. In the centre of my mirror cover is a small button for lifting cover off and on. This is placed in the tube as near the centre as I can judge, and there is no need to be to a hair-breadth. Next I place the flat in, seeing that it is somewhere near its place. In one end of drawtube I place a short piece of tube (mine is made of paper), with two fine pins or needles crossing each the other at right angles. The point of crossing is the centre of tube. At the other end (the eye end) another short piece of tube holds a penny piece, with a hole about the one-twentieth of an inch in the centre. Looking through this, the crosswires at the other end are visible, and the reflection of the button on speculum cover is seen in flat. Now I bring the centre of the button apparently in a straight line with aperture and wires by altering the flat until it is so. When once the cross point of the wires is perfectly central over button of speculum cover, the flat is in perfect adjustment. Then I uncover the speculum, and if the reflection of flat is not central, I put one hand on open end of tube so as to see which side I see too much of, and use the adjusting screws under speculum to bring it right. The image of speculum reflected in flat, if the least wider one side than the other, is immediately visible, and the wide side is the part requires screwing up to bring matters right. The whole adjustment of a 9in. reflector occupies me about two minutes, and I always have both mirrors to adjust.

Mr. Herbert Sadler has been kind enough to inform me that the double star following Σ 385 is not in any double-star catalogue. He says it is "Arg. (+ 59°) 661, the place of which for 1880 is IIIh. 19m. 55·5s.; + 59° 29·9′. It is 9th mag. in Arg., and follows Σ 385 41·7s. and is 1·4′ to the south of that pair."

Both "F.R.A.S" and Mr. Franks have made some remarks upon Saturn bearing more magnifying than Jupiter. I should like to know their experience of Mars. I always find Mars worse than either Jupiter or Saturn. His limb is less sharp and far more unsteady. In fact, he is always a more difficult object than Uranus even.

Edwin Holmes.

MICROSCOPIC TEST OBJECTS.

[22076.]—Those readers of the "E. M." who are interested in the resolution of the more finely marked diatoms, and who have seen or heard of the magnificent image of *Surirella gemma*, mounted in phosphorus, shown by Mr. J. W. Stephenson at the R.M.S. meetings and conversazioni, with a Zeiss' oil immersion $\frac{1}{8}$th objective, and his own catoptric illuminator, will be glad to learn that Möller now supplies some of the more difficult test objects mounted in highly refractive media. Having recently purchased a slide of *Amphipleura pellucida* mounted in phosphorus, and one of *Surirella gemma* mounted in monobromide of naphthaline, I will give the result of my examination of them. The resolution of the hemispherules on the latter was not remarkable, being much the same as that obtained on a slide of the object mounted dry. The resolution of the former, however, was all that could be desired with the means at my command, and contrasted favourably with anything I had seen before. Previously, with a Powell and Lealand's water immersion $\frac{1}{8}$th objective, and Wenham's disc illuminator, I had seen the striæ very faintly shown on a balsam-mounted slide. Much better resolution had been effected on a dry mount by a P. and L. oil immersion $\frac{1}{25}$th objective, and their achromatic condenser. But even this result was not to be compared with that obtained on the phosphorus mount above alluded to. Using P. and L.'s oil immersion $\frac{1}{12}$th objective (N.A. 1·43), and their oil immersion condenser, the striæ came out remarkably clear and sharp, and, though not distinctly broken up into dots, gave apparent in cations of a want of continuity. It would be teresting if other observers who possess la angled object glasses, and corresponding means illumination, would give their experience in rega to the new slides of these difficult but fascinati objects. **Edmund Carr.**

Holbrooke Hall, near Derby.

BICYCLES AND TRICYCLES.

[22077.]—I was on the point of writing a lett to the "E. M." asking riders of different machines to give their season's experiences, so as to complet the series of letters which in the spring mainly dealt with theory. But I am pleased to see that "Y. B." has already done so.

In reply to "Y. B.'s" second question, which is the only one on tricycles which I care to answer, I must say that I do not believe in gears. It seems absurd to be always carrying about a lot of wheels, which, even though they only work together when set for power, are always a dead weight, and then do not give the theoretical increase because of the new friction involved. For other reasons, too, I do not believe in them, for I think slow riding up hills a mistake, as every stone, every little obstruction is separately felt; whereas, by going faster, the momentum carries the machine over them. It is, of course, clear that more force will be required to go faster; but then it lasts over a shorter time, and the labour of fighting individual obstructions is avoided.

Again, we who are riders of the Otto never dream of riding less than 54in.—most ride 56in.; 60in. and 65in. speeding I have tried, and found delightful. Everyone knows that the Otto does not keep tricycles, or even bicycles, waiting up hills. Having this ample power for hill-riding with our high wheels, we naturally wonder at the fuss that is made by people over 30in. and 40in. gears.

"Y. B.'s" difficulty on hills is most natural: till the rider of the Otto has sufficient confidence in himself and in his machine to lean well forward at each tread, swaying back for the dead points, he cannot get up hills at all. So soon as "Y. B." has acquired this knack, so soon will he look forward to a hill as a pleasant change from the level.

If "Y. B." has already learnt the art of riding down hills, he may safely reckon on soon being able to ride up. Most people find they can ride up first.

I do not understand the spinning round of the Otto to which "Y. B." refers. He probably does not mean the apparently reversed steering, which beginners invariably imagine to be necessary down hills. It may be that, when nervous, he tries to back treadle and steer at the same time, which, of course, is wrong; the new brake gives ample stopping power. Or it may be that his machine is not kept in proper condition. When the handle is turned outwards, does it spring back quite freely? If not, oil or clean the stiff place till it does.

So little fear have I of ever breaking a driving-band, that when I started for my autumn's tour of about 1,300 miles I did not think it worth while to take a spare band with me, though one weighs nothing, and will go into my pocket. If a band did break, which could only happen when labouring up a very steep hill, the rider would merely step on to the ground; no harm could happen to him or his machine.

I am glad to say that my autumn's experience bears out everything I said of the Otto in my four previous letters. In the country between Lincolnshire, Norfolk, London, Southampton, Devonshire, and Cheltenham I have this autumn met with roads of every kind—from the most perfect to the worst that can be imagined, from impossible hills to a dead level. Nowhere had I the slightest difficulty in shooting past the few tricycles which I saw about, and with some of which I rode a little way. I found that about 70 miles made a comfortable day's run, though on some occasions it was convenient to do much more than this, and on others less. I have experienced no difficulty whatever down the hills. The steepest which I had occasion to ride down was the main street in Lyme-Regis, going east. This at the bottom is rather a severe trial, and I should recommend beginners not to practise there. I did not ride down some few of the hills in Devonshire, where many loose stones made them really dangerous; it would have been absurd to have done so.

I carried all my luggage in a home-made satchel 20in. long and 5½in. in diameter, hung under the axle and tail by three spring hooks. I had no lamp.

Of course I am a member of the C.T.C. Let me, therefore, acknowledge the uniform attention which I received at the headquarters in all parts.

An Ottoman.

TRICYCLES.

[22078.]—The following experience may be of service to "Y. B." and others seeking information. I have used [illegible]

[illegible] science of mechanical [illegible]

[illegible] grammar, and naturally [illegible] cases usually [illegible] grasp, and won't [illegible] mysterious letters that give a [illegible] the facts they have [illegible] they are even annoyed at [illegible] delighted when the amateur [illegible] want of manual dexterity [illegible] exceptions. Let them rest [illegible] skill and dexterity can never be [illegible] of practice, and so far the [illegible] will always hold his own and be [illegible] the more machinery is brought into use, and the [illegible] dexterity and skill are necessary [illegible] brains and reason be a match [illegible] observation.

The remarks in the last paragraph were suggested by an article in Vol. XXV. p. 405. Everyone must have the greatest respect for Mr. Rose's [illegible], but I cannot help thinking that it would have been better to have tried to reduce the various modifying influences to something like order, and shown (supposing theory to be right in the main) how these general rules required modifying to meet various cases, than to assert the impossibility of ever doing away with the so-called rule of thumb. Mr. Rose may not be able to do it, but done it will be some day, to a very large extent. Take the case of which an illustration is given, where the writer argues that it is no use giving rules for the clearance, or "angle of relief," because it must vary with the feed. To which the answer is: Show how it varies with the feed then. The feed makes no difference to the clearance of the front face: but as regards the side cutting the shoulder, a [illegible] feed does take off some of the clearance, for the [illegible] edge is now planing down a slope, and the effect is like what would be produced in a planing machine by sloping the standards carrying the tool the way the table travels: and, of course, if the tool have [illegible] clearance, sloping the standards with respect to the table reduces that clearance by the same amount. Roughly speaking, for lathe work the feed in eighteenths, divided by the diameter of the work in inches, gives this slope or angle taken off clearance. Feed in eighteenths [illegible] small angles, and the [illegible] for pitch of the screws. [illegible] for facing a surface [illegible] with continuous feed. [illegible] must be greater, the amount [illegible] with [illegible] feed on [illegible] take the place of [illegible] think the [illegible] and [illegible]

[illegible]

Bow.

[illegible] LIGHT

[illegible] closed [illegible] the same [illegible] also [illegible] intense as [illegible] Huxley perceived [illegible] peacock's tail, sur- [illegible] I cannot, for all is as [illegible] I remember, when a boy, [illegible] boy's head, each [illegible] a dark passage, [illegible] and presented [illegible] Also on passing [illegible] with a chain band [illegible] closed eyes, I saw a [illegible] I may presume, and I [illegible] that the sunlight I [illegible] phorus, forming so [illegible] per cent. according [illegible] situated in this [illegible] the motion, that [illegible] spot was [illegible] minute atoms [illegible] radiating from it [illegible] It was as a fountain reversed [illegible] and every particle dissolved itself into this centre light. Perhaps I saw an image of the back of the eye, and afterwards an image of the multifarious brain; but how to account for the motion I know not.

The impressions of light on the retina (with the eye open), according to Dr. Roget, is "compared to the revolution of a wheel made to revolve behind a series of perpendicular bars which change in appearance from radial spokes to curved lines." But I saw no lines and no radius, only a continuous outward movement, which was in reality an inward impression. As I know of no motion in nature like this, I shall be glad to be informed of a probable cause and origin, for perhaps the brain has this sensational movement at all times as an involuntary condition.

Fiddler.

CONTINUOUS BRAKES.

[22082.]—Your correspondent "Imprimatur" (letter 22061, p. 265) must have a very small idea of the intelligence of the readers of the English Mechanic if he imagines they cannot see through his letter—especially when the same statements have long ago been paraded before them, and their true value exposed. "Imprimatur" carefully sets out the number of miles run with the respective brakes and the "failures" recorded; but he does not take the trouble to explain what the word "failures" means. Given a brake which always indicates when it is not in a condition for working, it is obvious that more "failures" will be reported with that, than in the case of a brake which gives no indication that it is out of order, and which too often fails when it is most wanted. Your correspondent either knows this fact or he does not; if the latter, he should not write upon what he does not understand; if the former, he has to answer the charge of deliberately suppressing the truth. So far from the returns showing "unfavourable results" for the Westinghouse brake, anyone who will take the trouble to examine them in a manner which will lead to their comprehension, will discover, as all disinterested engineers have, that the Westinghouse automatic brake is the only really trustworthy appliance in existence. The child-like innocence with which "Imprimatur" descants on the merits of the mechanical brake which he has apparently taken under his special protection, is amusing; but he should favour the daily papers with his encomiums—they will not wash in these columns. By way of a parting shot, let me ask "Imprimatur" if he can give the details of any instance when one of his "failures" of the Westinghouse brake was the cause of an accident? What does he mean when he says (p. 266), that "it is known to all that it is the continuous brake that frequently produces the catastrophe"? That must be one of the "failures"—probably one not recorded.

Nun. Dor.

[illegible]—Your correspondent "Imprimatur," [illegible], furnishes a long and perfectly misleading statement relating to the brake failures, and remarks that as it is from the *Railway Engineer* the accuracy can hardly be questioned.

I think it may not be known to all your readers that this paper has for a long time made false statements with regard to the Westinghouse brake, and in May last the editor published a public apology in which he regretted having written statements all which he thereby acknowledged to be unfounded, and he was advised they were libellous. An action for libel was brought a few months ago, and damages were awarded by the jury.

With such facts as these before us, I do not think the readers of the "E. M." will think the *Railway Engineer* an impartial authority.

The Board of Trade requires that the failures should be given under the three following heads:—

(1.) Failure or partial failure of the continuous brakes to act when required in case of an accident to a train, or a collision between trains being imminent.

(2.) Failure or partial failure of the continuous brakes to act under ordinary circumstances to stop a train when required.

(3.) Delay in the working of trains in consequence of defects in, or improper action of, the brakes, distinguishing whether they arose from neglect or inexperience of servants or failure of machinery or material.

It will be seen that the importance of a "failure" depends upon which class it comes under. No. 1 is very serious indeed. No. 2 shows that no accident took place because, fortunately, there was no obstruction in the way. No. 3 is of very little importance, as simply a few minutes' delay took place.

Now, the list given by "Imprimatur" is artfully drawn up so as not to show to which class a "failure" belongs: it simply give a total number of cases and total miles run. An accident caused by the failure of a vacuum brake counts *one*, and of course a delay of a minute to the Westinghouse brake also counts *one*; but surely there is a wide difference between an actual collision and a few minutes' delay. Will "Imprimatur" be good enough next week to furnish another list, showing the failures placed under the three heads as required by the Board of Trade?

As I pointed out in my pamphlet (Railway Accidents), to draw up a proportion of failures to miles run is absurd, as some trains with one brake run a hundred miles without stopping, and others having another brake perhaps stop a hundred times in running the same distance; therefore, a fair comparison cannot possibly be made unless further information be given.

The chain brake on the L. and N.W. shows a very large mileage and few faults. This brake is used in "emergencies," it is therefore *carried* over a number of miles, but is not regularly worked; a comparison therefore is useless.

The "two-minute vacuum" on the Midland shows a large mileage, but few faults. There have been cases of running into buffer stops (which should come under class 1), and very many runs past stations (class 2), yet none of these instances are reported by the company to the Board of Trade; the returns, therefore, are rendered practically useless.

"Imprimatur" expresses a strong opinion in favour of mechanical brakes, and considers them superior to fluid systems. He is perfectly justified in holding his own opinions, but I wish he would give some facts in support of them.

Is any company at the present day adopting or thinking of adopting mechanical brakes? On the other hand, are not many lines removing them?

The London and North Western has had great experience with "mechanical" systems on its own line, and its officials have inspected all those used on every line in all parts of the world, yet the result is that mechanical systems cannot be made satisfactorily. After the chain brake had been adopted at great cost, we may rest assured that its removal would not have been ordered so long as there was any chance of improving it. I have been informed by an official that if the company had considered the Parker-Smith system likely to be efficient it would have been tried with a view to its adoption in connection with the chain brake gear.

The battle of the brakes has for a long time been settled, so far as discovering which is the *best brake*; the difficulty now is to remove obstruction caused by private interest. As long as the companies can continue to do nothing, or very little, so long will the brake question remain in the present dangerous state. If Parliament were to pass an Act (as I trust it will do next year) compelling companies to adopt brakes which fulfil the Board of Trade conditions, private interest would have to give way, efficient brakes would be adopted, and the safety of the public provided for.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Nov. 24.

LONDON AND MANCHESTER TRAINS.

[22084.]—As I notice that a correspondent asks for particulars of these trains, I give a list of the fastest by each of the three routes, taken from the time-tables of this month. Below are the trains which take less than 4h. 40m.:—

Midland Route—distance 186¾ miles.—The fastest trains by this route are the 3.30 p.m. from St. Pancras and the 3.45 p.m. from Manchester. Both of these trains take 4h. 35m.; one makes three and the other six intermediate stops, including Kentish Town; they are drawn by 7ft. coupled bogie engines.

London and North-Western Route—(I am not sure of the exact distance, but it is nearly the same as the Midland). There are two trains by this route which take 4h. 30m.—namely, the 10.10 a.m. from Euston, and the 4.15 p.m. from Manchester; another train, the 11.15 a.m. from Manchester, takes 4h. 35m. These trains make seven, four, and five intermediate stops respectively, including Willesden, and are drawn by 6ft. 6in. coupled engines.

Great Northern Route—distance 203 miles.—These trains are G.N.R. and M.S. and L. joint. There are four, the 2 p.m. and 6.15 p.m. from King's-cross and the 11 a.m. and 2 p.m. from Manchester, all taking 4h. 30m. and making two intermediate stops. They consist of only five carriages, and are drawn to Grantham by G.N. 8ft. bogie engines, and thence to Manchester by M.S. and L. 7ft. 6in. single engines. (Perhaps "R. N. H." will give the other dimensions of these engines.) Though the distance is much greater by this last route than by the other two, no difficulty is found in keeping time, as the following extract from a local paper will show:—

The New Fast Trains to London.—On Monday the Manchester, Sheffield, and Lincolnshire Railway Company commenced running new express trains between Sheffield and London, at the times and under the conditions of speed already mentioned in these columns. The journeys were practically "trial trips," and they proved most successful ones. The first train leaving Manchester at 11 a.m. reached Sheffield at 11.53, or 8 minutes before time, being due in at 12.1. At 12.5 it proceeded on its journey, [illegible] of the forefinger of the left hand. [illegible] toward direction at which the [illegible] to be changed, the whole position [illegible] will have to be altered. At the [illegible] of the cut, the edge of the razor should [illegible] beyond the thumb or finger nail, as the [illegible], and it is well for the two hands to [illegible], as the mere fact of doing so seems to steady [illegible] and to make any change of position more [illegible] perceptible. The elbows may be rested on [illegible]ble, and while the section cutting is going on inadvisable to lay the razor or the object [illegible] and take them up again oftener than be helped, since the direction of the cuts [illegible] thus almost inevitably be changed, so the under surface of the section would not rallel to the upper. Having made a first cut tain an even surface, wet the razor well by ing the point into water or spirit and slanting lade so that it runs toward the heel; wet the ce of the object also. Pressing somewhat lightly with the blade on the edge of the b or finger nail (which will give the thickness e section), make a second cut, preserving as s possible the precise direction of the first. A or less perfect section will then be left on the e, and may, if thought good enough, be ed off into a mounting pot (*e.g.*, a toothpaste as previously described), three parts full of r, glycerine and water (which may also be for moistening the razor), spirit, or staining, according to circumstances. To float it off, ; the razor from heel to point, so that its point neath the surface of the liquid. Wetting a l's hair pencil from the liquid, touch the blade it behind the section. The latter will then down in the little stream thus created, and be assisted by the pencil in doing so. The point that remains to be noticed (besides the of carefulness not to cut the thumb, or, as it be, the finger of the left hand, against which razor comes when it has finished cutting the t), is that thin sections are liable to double in bing up (as it were) the razor blade from edge ck, or to be torn on account of the diagonal on. To prevent this, first, use plenty of liquid e razor; second, slant it somewhat, so that it upward, and the section falls by its own ht; third, get a second person to "doctor" or the section along with a wet camel's hair il. Two can always cut sections better together than one by himself. If the object has a ate side, cut beginning from that side.

fore speculating in a microtome, it is best, I k, to practise hand cutting. For instance, cut piece from a raw potato with a knife. It is use cutting a piece with a larger cross section can be placed under a covering-glass, with a margin at the sides. With this try the above tions. There will probably, at first especially, any imperfect sections. Wave these with the [illegible] fingers in a glass of clear water. A fine [illegible] will come from them, and settle at the [illegible]. This is potato-starch. A little of it may ken up in a tube, transferred to a glass slip, ted, and inspected with a polariscope. The h granules will show like little packages tied a black string, and may easily be mounted. [illegible], pour the sediment into a test tube, filling with fresh water and allowing the opalescent d partially to settle, when the larger and [illegible] particles will come to the bottom first, and [illegible] may be poured off. This way of separating from light is called elutriation; it is of considerable use [illegible] in mounting diatoms; and this ample example of it. The tube being nearly, not quite, dry, half fill with methylated spirit, repeat the process after a little time. When [illegible] of the emptied spirit are nearly dry in [illegible] pour in a drachm or so of chloroform. Give it to penetrate, and then, with a tube, put a drop starch containing chloroform on a slip, whereupon when the chloroform is nearly dry, put a drop [illegible] and Canada balsam, and cover with a ing glass. Other kinds of starch (*e.g.*, that h falls out of a [illegible] stock of celery) may be [illegible] in the same way. Meanwhile, as the dry[illegible] is going on, other sections may be cut. [illegible] of them should be examined fresh; and the [illegible] at least the best ones.

[illegible] staining is either single or double [illegible], of which the second is, naturally, more [illegible]. A multitude of staining fluids are in [illegible] but for the present, as anyone who has cut [illegible] will [illegible] of staining and mounting [illegible], I will give a simple way of using extract of [illegible], [illegible] logwood, by which almost anything [illegible] be stained. Take [illegible] hæmatoxylin, thirty grains, alum, three [illegible]. Break the hæmatoxylin small pieces, and add a few teaspoonfuls of [illegible] with which it will form a semi-fluid mass. with the [illegible] and a half of boiling water, [illegible] which it will form a turbid solution, and add [illegible] the alum dissolved in rather less than two [illegible] of boiling water. Mix the two solutions, through blotting paper, or Swedish paper. [illegible] of spirit, fill up to [illegible] with water, and keep in a (corked will do) bottle, the composition of the logwood staining fluid being written on the label. When wanted, take a sufficient quantity of the fluid, add about eight times the amount of water, and therein leave the sections or other objects till sufficiently stained. Then transfer to methylated spirit, then to benzol, turpentine, or oil of cloves, and mount resinously, as previously described.

IV. *Various Practical Details.*—To use a dipping tube, which ought to be made almost capillary at one end and left open at the other, dip the tube into the liquid of which it is desired to take a small portion for examination. Close the open top of the tube with the thumb, and on removing the tube the liquid will not escape. By cautiously and partially removing the thumb, it will flow out; or a little will do so on warming the tube—e.g., by the heat of the hand. Small objects may also be made to enter the tube, if its lower and narrower opening is made a little larger. For changing liquids in which objects are immersed, a tube with a finer ending may be used (the finer the ending, the less the objects are disturbed), part of the liquid being sucked up, squirted out again, and the process repeated. This is much more cleanly than a syringe, as the thread round the piston of a syringe inevitably becomes soiled, however great care be taken to prevent the liquid from touching it. There is but little danger, after a few trials, of the liquid entering the mouth, if the suction is effected, not by drawing in air into the chest; but by closing the back of the mouth, as in saying the ck of the word back and sucking, by making a cavity between the top of the tongue and the roof of the mouth, placing the tip of the tongue against the tube when this space is filled with air, and repeating the operation till no more liquid can be drawn in this way from the mounting pot, or pot containing the objects. The mounting pot may then be placed on its side to drain; and the next fluid afterwards cautiously poured in without incurring the danger of breaking involved in shifting thin section, &c., from one pot to another, which is, however, the most cleanly way for the sections. It is best immediately to move them about in a new fluid, as otherwise—e.g., in turpentine after spirit, they may cling to the bottom or sides; they are best moved by creating a current in their neighbourhood, or they may be lifted from one pot to another containing the new fluid, by a piece of fine gauze wirework, or by inserting the blade or handle of a scalpel into the liquid, and coaxing them on it with a camel's hair pencil. To clean sections, they may be gently brushed as they lie on a slip, with the turpentine, &c., in which they have previously been immersed. A drop of clean turpentine may be poured on them: it will spread over the slip, washing the dirt before it. The dirty turpentine surrounding the section may then be removed with a handkerchief, and the same thing done again. Some objects, again, will bear rougher treatment than others—e.g., they may be taken up by the forceps (holding them, preferably, by some part which it is not desired to mount), and waved in the fluid, and any visible dirt may be removed with with a stiff hair from a badger brush, fastened to a penholder by tying round with thread. This searches into nooks and crannies.

F. Grant.

ERRATUM.—**Humidity and Chronometers.**—With reference to this question (see pp. 237, 266), Mr. Crisp writes to say that the name of the station, the temperature, &c., are *not* given in the communications referred to.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51656.]—**A Three-Cell Battery.**—In respect to "No Sig.," as to size of cells, carbons, and zincs, are as follows:—Size of outer jar, 10in. by [illegible]in.; porous cells, 11in. by 2¾in.; carbon plates, 9½in. by 2¼in. by ½in. Zincs in the shape of a tube and open down the middle (being much better than the rods) 11in. long by 2in. diameter. I notice the light becomes fainter after the battery has been in action for about four hours together. Then the action should be stopped for some hours on purpose for it to recover its strength again. For other information I refer our reader to replies of the [illegible]th September and 26th October, under the above heading.—ELECTRICIAN.

[51792.]—**Cancer in the Mouth.**—I am extremely sorry that I have been unable sooner to answer Dr. Allinson's question, [illegible] epidemic of typhoid which has kept me [illegible] employed. The cases to which I [illegible] almost entirely amongst hospital patients [illegible] have no detailed notes of most of them [illegible] safely say that nearly all of them smoked [illegible] pipes—many to an immoderate extent. [illegible] call to mind one who [illegible] smoked cigars or cigarettes [illegible] impression is that [illegible] many of my medical acquaintances [illegible] irritation of the porous clay is at least the exciting cause of this complaint.—ST. BART'S.

[51961.] — **Cementing Object Glasses.**—Will you kindly permit me to state briefly the result of my experiment with castor oil as a cement for object glasses. After no little trouble and messing, I obtained what appeared to be a perfect film between the glasses, and, when now examined the transparency and clearness of the lenses were most pleasing. Upon trial, I found the focus shortened by nearly 2in. The light was certainly improved. A small satellite of Saturn—which an hour before was only suspected under almost identical conditions of light—was now held steadily, and what was also very striking was the comparative blackness of the surrounding field. On examining the planet, however, for definition, I was grievously disappointed. It would not focus sharply, and there was a most unmistakable fringe of blue. Perhaps there was too much oil between the lenses, as a good deal exuded after screwing up. In their normal condition the surfaces are in perfect contact. If the defective definition and colour could be overcome, then the improvement otherwise would well repay the trouble of occasionally renewing the oil.—ACHROMATIC.

[52003.]—**Defective Coil in Galvanic Battery.**—If "J. D." expects an answer to this query he must say what it is he really wants to know. To enable him to do that he may be safely referred to back volumes, when, by diligent reading, he will probably find what he requires to know. At present, his query is a bit of a puzzle.—NUX. DOR.

[52010.]—**Lifting Water.**—This querist should try what can be done with a hydraulic ram, which, I fancy, would give more satisfactory results than a turbine, considering that the fall is only 5ft. He will find a great deal of information in Mr. Davies's articles and recent letters on rams.—ESSAR.

[52014.]—**Sawmill Waste.**—"Sawyer" should advertise his "waste," giving particulars, as much of it would evidently do for hammer and other tool handles, and for general turner's work.—ESSAR.

[52017.]—**Heating Water.**—Cannot "Bernard" take the lime out of the water, and then heat the latter in the ordinary way?—ESSAR.

[52022.]—**Light-waves.**—Does not "No Sig." see that if we could see and measure what he calls the altitude of light-waves, it would settle beyond all possibility of doubt any dispute as to the undulatory theory? Just as the intensity of a sound is due to the amplitude of the sound-wave, so presumably is the intensity of light due to the amplitude of the light-wave. The querist should refer to some textbook of physics.—NUX. DOR.

[52025.]—**Afterludes.**—I suppose this querist would find something to suit him in the catalogues of Novello and Co. and the other music publishers.—DIAPASON.

[52026.]—**American Clocks.**—So far as all the information conveyed by this query is concerned, it is only possible to guess that the clocks want regulating, or else are worn out. Better try another "clocksmith," unless you can persuade a real "horologist" to undertake the work: but I warn you, he will probably consider his time wasted on such clocks.—NUX. DOR.

[52027.] — **American Egg - Boilers.** — If "Dux," with his egg-boilers before him, cannot discover why they stop running, how can anyone who has not seen them? Perhaps the sand is too large in the grain.—NUX. DOR.

[5203[illegible].] — **Street Medical Coil.**—Put your bundle of wires forming the core and the brass tube into a paper tube made on a mandrel just large enough to allow the brass tube to fit loosely. Wind your wire on the paper tube. If you mean the description given on p. 23, Vol. XIX., it is plain enough if you think it over with a knowledge of the principles.—NUX. DOR.

[illegible]—**Valve-Spindles.**—Querist does not state what valve-spindles, but I do not think rubber can be used as packing unless there is a coat of asbestos fibre between the rubber and the spindle. If for a steam engine, the heat will surely affect the rubber before long.—ESSAR.

[illegible]—**Punching Machine.**—My answer to "[illegible]" was as plain as I could put it. What is your difficulty? All you require is to multiply the circumference of the hole by the thickness of the plate in inches and by the shearing strength of the plate in tons per sq. inch for an answer. As you have altered the thickness from 2in. to 2[illegible]in., and the shearing strength from [illegible] to 34 tons per square inch the answer will be—3·1416 × 2 × 2·0625 × [illegible] tons. I have not taken the taper of the hole into consideration in the above.—S. NICHOLLS.

[illegible]—**Engine.**—As I asked the Editor's permission, [illegible] not having been granted, I had [illegible] of sending my letter on the [illegible] "Essar" wishes it, and [illegible] permission, I will send; but at the same time I have no intention of opening out a controversy in the "E. M." (especially such as that on "Thought Reading," from which I think very few have derived benefit), neither should I persist in my method of calculation if it was clearly shown that I was in the wrong. "Essar" is good enough to warn me to take care, otherwise I may lose myself. This is quite possible, yet I think I am aware of some of the practical advantages of the compound over the single-cylinder engine; but I should like to ask "Essar" if ever he obtained a greater theoretical power from a compound than from a single-cylinder engine with the same number of expansions and measurement of steam. If so, how?—Engineer, Dewsbury.

[Please send.—Ed.]

[52118.]—**Tarring Posts.**—The querist must get his timber as dry as practicable from sap, &c. The parts inserted in ground should first be charred, and afterwards well soaked with a composition of ¾ tar and ¼ pitch, well boiled, into which a sprinkling of quicklime is stirred. The rails above ground having two coats of this will be proof against all kinds of weather.—E. Owen.

[52128.]—**M. S. and L. Engines.** — The M. S. and L. engines in question (Nos. 500-509) were built at the company's works at Gorton this year. They have outside cylinders 18in. by 26in., and single driving wheels 7ft. 6in. diameter. The boiler is not so large as in the general types of M. S. and L. engines, and the firebox is raised. The leading and trailing wheels have outside frames, this outside frame being carried on over the driving wheel, but not connected with it. The connecting-rod is nearly hidden by the framing. The engines are somewhat similar to No. 399 (1882); but 399 has plain splashers, the new ones having a pattern of ovals in the driving splashers. The expresses between Manchester and Grantham run by these engines do not average above five or six carriages.—Meteor.

[52207.]—**Boring Cylinder.**—Granting what you have stated correct, in my opinion, as an old hand, you were not in error with the job; but in the first place, I should like to know how the line was obtained with the rough casting, and also would the 1/16 bare, as shown by the foreman's gauge, materially signify, and were the lathe shears true? He reported you as confident and not so good at explaining. Now, in my opinion, here the magnitude of fault occurred.—W. Mc.

[52210].—**Stereoscopic Camera.** — Originally the size of stereoplate was 5¼in. by 3¼in., the distance from centre to centre being, of course, 2¾in. This was subsequently increased to 6¾in. by 3¼in., the distance from centre to centre being 3⅜in. Decide what sizes you will adopt, and fix your lenses accordingly; or what is still better, have the front of camera so made that the lenses can be separated or brought closer together as required. Lenses of 6in. focus are about the best for general purposes. The prints should be trimmed and mounted, and the separation of the stereoscope lenses arranged to correspond; but as to the focus of the latter, that is mainly a matter of individual idiosyncrasy.—W. Robinson, Jun.

[52211.]—**Electric Formula.**—To find the potential due to a solenoid at an external point P: Let V_P be the required potential, and let $+m$ and $-m$ be the powers exerted by the poles of the solenoid (taking the south-seeking pole as negative), and r_1 and r_2 the respective distances of the said poles from the point P; then $V_P = m\left\{\frac{1}{r_1} - \frac{1}{r_2}\right\}$. J. Crocker will probably find an answer to the first query in "Electricity and Magnetism," by Silvanus P. Thompson, published by Macmillan and Co.—A. R. D., Hale, Lancashire.

[52218.]—**Medical.**—"Assistant" is still suffering from the cold which caused the congestion of the left lung. He would do well to put 5 globules of thuja, 5 globules of verbena, 5 globules of bursa in a pint of water, or a little more, and drink it in small quantities at a time. Wet a piece of flannel in the same water, and put it cold on the skin over the place where the pain is. He has no need to fear these remedies, as they are extracts of herbs not poisonous.—Etheropathy.

[52220.]—**Collotype Printing.**—I experienced some difficulty in my earlier experiments in collotypic printing, as the film would not adhere to the glass; but directions as to the method adopted by Herr Albert, of Munich, which I found in "Pritchard's Studios of Europe," enabled me to work the method with success. I obtained the book at the office of the *Photographic News* in Castle-street, Holborn.—James Bradford.

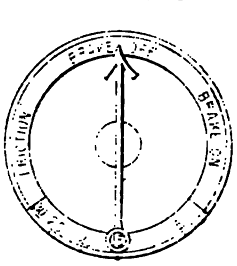
[52220.]—**Collotype Printing.** — Most likely owing to the use of too soft a gelatine, or too stiff an ink. I am not aware of any work on the subject in English, but there is a French book by Geymet, entitled "Traité pratique de Photolithographie et de Phototypie," published by Gauthier-Villars, 55, Quai des Augustins, Paris, price 5fr., which would probably contain all necessary information. There is also a series of articles by Mr. Bolas in the "British Journal of Photography," 1878-9.—W. Robinson, Jun.

[52219.] — **Geometrical Problem.** — Taking the centre of the larger circle as origin, and the line joining both centres as axis of x, the equations to the circles are — $x^2 + y^2 - R^2 = 0$, and $x^2 - 2rx + y^2 = 0$. ∴ they cut at the point $x = \frac{R^2}{2r}$. From equations above, we have $y = \sqrt{R^2 - x^2}$ and $y = \sqrt{2rx - x^2}$ ∴ area common to both circles is $\frac{\pi R^2}{2} - 2\int^{\frac{R^2}{2r}} (\sqrt{R^2 - x^2} - \sqrt{2rx - x^2})\,dx$.

$$\therefore \frac{\pi R^2}{2} - \frac{R^2}{2r}\sqrt{R^2 - \frac{R^4}{4r^2}} - R^2 \sin.^{-1}\frac{R}{2r} + \frac{2r^2}{2}\cos.^{-1}\frac{2r^2 - R^2}{2r^2} - \frac{(2r^2 - R^2)R}{4r^2}\sqrt{(4r^2 - R^2)} = \frac{\pi r^2}{2}. \quad \therefore R^2 \cos.^{-1}\frac{R}{2r} - \frac{R^3}{4r^2}\sqrt{4r^2 - R^2} + r^2\cos.^{-1}\frac{2r^2 - R^2}{2r^2} - \frac{(2r^2 - R^2)R}{4r^2}\sqrt{4r^2 - R^2} = \frac{\pi r^2}{2}.$$

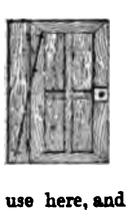
We may obtain this result also by mensuration, thus.—Join the common points; this chord divides the part common to both circles into two segments. Calling x the perpendicular distance of the centre of the larger circle from this common chord, we have (3·36) $R^2 - x^2 = x(2r - x)$. ∴ $x = \frac{R^2}{2r}$ in area of segments $= R^2\cos.^{-1}\frac{R}{2r} - \frac{R^3}{4r^2}\sqrt{4r^2 - R^2}$ and $r^2\cos.^{-1}\frac{2r^2 - R^2}{2r^2} - \frac{(2r^2 - R^2)R}{4r^2}\sqrt{4r^2 - R^2}$. The sum of these $= \frac{\pi}{2}\cdot r^2$. Cancelling, we obtain $R^2\cos.^{-1}\frac{R}{2r} - \frac{R}{2}\sqrt{4r^2 - R^2} = r^2\sin.^{-1}\frac{2r^2 - R^2}{2r^2}$. This equation gives the relation between R and r, but the solution of it is rather abstruse.—C. Relle, Devonport.

[52227.]—**L. and N.W.R Vacuum Brake.**—In reply to H. W. Hudson, as has already been stated in the "E. M.," the Webb brake, recently adopted by the above company, is not automatic except on the guard's van. Each van has, besides the vacuum apparatus, an automatic friction brake, which, while the train is running, is kept out of gear by a slight amount of vacuum, maintained by a small ejector throughout the train. The vacuum brake is applied by the driver using the large ejector, and if the train divides, the entire vacuum is destroyed, and so the friction brake goes on. Inclosed is a rough sketch of the gauge used. Before



coupling up the train, the needle points to the left. When the train is ready to start, the small ejector is taken off the friction brake and brings the needle into the position shown. When the large ejector is applied, it flies to the right and indicates how much vacuum is obtained. This is not the same as the brake used on the L. and S.W.R., which was illustrated in the "E. M." some six months ago.—W. Thompson, Rugby.

[52231.]—**Spring for Door.**—Attach a steel rod about 5ft. or 6ft. in length and ¾in. in diameter behind the door as shown in sketch. We have a



great many such in use here, and they answer admirably.—F. R.

[52231.]—**Self-closing Doors.**—I beg to recommend to "Chemicus" the "Premium Door and Gate Spring," which is the most simple and effective arrangement for closing doors I have met with. The spring is easily fixed, and can be taken off should the door at any time be required to be left open without removing any fixtures, the spring having merely to be slipped off the pivots.—G. Fowler.

[52236.]—**Combining Weights of Tartaric Acid and Bicarbonate of Soda.**—These may be calculated by adding the combining weights of their components together thus, $NaHO_3$:—

$$\begin{aligned} Na &= 23 \\ H &= 1 \\ C &= 12 \\ O_3 &= 48 \\ \hline \therefore NaHCO_3 &= 84 \end{aligned}$$

Also $H_2C_4H_4O_6$, or $C_4H_6O_6$:—

$$\begin{aligned} C_4 &= 48 \\ H_6 &= 6 \\ O_6 &= 96 \\ \hline \therefore H_2C_4H_4O_6 &= 150 \end{aligned}$$

The combining weight may also be determined from the specific heat: because combining weight × specific heat = a constant. This constant is found thus:—

	Specific Heat.		Atomic W.		Constant.
S........	0·2026	×	32	=	6·48
P	0·2120	×	31	=	6·57
As	0·0814	×	75	=	6·11
Fe	0·1138	×	56	=	6·37
Pb	0·0314	×	207	=	6·50
Ag......	0·0570	×	108	=	6·16
Li	0·9408	×	7	=	6·59
				Mean,	6·40

—A. R. D., Hale, Lancashire.

[52237.]—**Jointing Material to withstand the Action of Soap Lees.**—"C. J. R." will find that if he uses fireclay moistened with weak muriatic acid upon the threads of the screws, he will have no more leakage. Lead in any shape is utterly useless with caustic alkali. As to the leakage in steam pipe, I take it that he only uses a small quantity of lye to correct hardness of water in the steam boiler. This would not cause the pipes to leak; it is caused by the water resting at the depressed part of the pipe. A small cock inserted there to let off the water at night, or a self-acting small valve, will remedy this.—Soap Boiler.

[52238.]—**Induction Coil.**—In this case the two sides of the condenser probably communicate. Let the querist attach a battery cell to the condenser, coupling up a galvanometer in circuit; and, if the sides communicate, there will be an instant deflection. —B. H.

[52243.]—**Lifeboat.**—If "Grace Darling" feels interested in the lifeboat, he can see a small model of one having all the advantages of which he speaks, and more, by applying to J. Bramall, 18, Ballantine-street, Wandsworth, S.W. It is similar to one I exhibited to the Secretary of the National Lifeboat Institution. R. Lewis, Esq., said then, eighteen years ago, that it was rather before its time.—Bramall.

[52244.]—**Analytical Theories.**—Most of these theories cannot be proved: as, for example, Ampère's theory of magnetism, in which electric currents are supposed to circulate round magnets. There is no demonstration that this is a fact. Sir W. Thomson calculates by theory the distance of the atoms of copper and zinc, but there is no proof that they exist. Maxwell supposes electrical and magnetic undulations to be produced in ether, which is most likely only an imagination like the theory of Phlogiston. Mascart considers that the ether is the same for all the forces—heat, light, electricity, and magnetism; but these forces are most probably caused by a vibration of matter in itself.—J. Sutcliffe.

[52245.]—**Lever Watch.**—In the first place, put the barrel-hook into the hole in the barrel, then wind the chain carefully on. This is done by catching the square of the barrel arbor with the pliers and turning it slowly round, keeping your thumb upon the chain, so as to prevent it from sliding off the barrel. When you have got all the chain on the barrel, pass the end that requires to be fixed to the fusee inside the pillars, and fix the hook to the pin. After you have done this, put the ratchet on the square of the barrel arbor, and give it about half a turn or so, just as much as will enable the mainspring to pull steadily to the bottom, not more; or, when winding, the mainspring will be full up before the chain is all on the fusee, and so cause it to stop short. Wind up the watch now, and if it catches before it is full up, it must be the stopwork that is not acting properly, which you will easily see, and be able to put right yourself.—Stanley.

[52247.]—**Photographic.**—(1) The main requisites are a small lens giving a perfectly sharp image, a structureless collodion (i.e., if the wet process be used), or an emulsion of the utmost possible fineness. (2) If you mean in regard to its behaviour with gelatin, the action is mainly a coagulatory one, and [illegible] the action of alcohol and silver nitrate [illegible] as a hypo-eliminator, I think [illegible] action is entirely [illegible] the citric, or [illegible] recommended to be used with it.—W. [illegible].

[illegible]—**Bunsen Burner.**—[illegible] The [illegible] should be [illegible] of an inch to [illegible] inch is enough for most purposes. [illegible] tinum should be best for spectrum analysis, but it would be very costly. [illegible] ducing" can be effected with an ordinary Bunsen, but of course at different points of the flame. In fact, it has an [illegible] English [illegible] 66 and 67. In some cases the [illegible] the better tool.—[illegible]

[illegible]—**Spectroscope.**—[illegible] Browning's work [illegible] on page [illegible] work [illegible] Browning [illegible] the source of light [illegible] Unfortunately [illegible] cut, and a [illegible] to guard against [illegible] the spectrum [illegible] I nearly [illegible] did. I [illegible] to one of [illegible] of these pocket [illegible] that I expected too much [illegible] the knack of using it, I was [illegible] satisfied with the result. I would advise [illegible] to pay from [illegible] for an instrument [illegible] to make one for himself.—Ex-Blacksmith, [illegible] Brock.

[illegible]—**Spectroscope.**—There are books on spectrum analysis by Roscoe, Schellen, Sutton, Proctor. The first is a series of lectures to chemists, the second treats of the whole subject very fully. These are expensive works—20s. to 30s. each. Sutton is a smaller book, chiefly on absorption spectra. Proctor is a capital little book, published at 1s., which goes over the whole subject clearly, though briefly. With regard to your other queries, I would recommend you, if you really mean to buy a spectroscope, to write to Mr. Browning, who advertises a rainband spectroscope, as to whether it or one of his direct-vision spectroscopes would suit your purpose. I have always found him very frank in giving the respective merits of his instruments. I should say the rainband spectroscopes would do just as well if they show the full length of spectrum, and are not exclusively adapted to show that part where the rainbands are found. It will altogether depend on the make.—Volvox.

[illegible]—**Lantern.**—The addition to your lantern which you ask about is called an aphengoscope, but it is not much use for ordinary work, as it requires too much light. However, a watch in motion, or small india-rubber dolls with flexible faces, photos on [illegible], and daguerreotypes are some of the opaque objects which may be tried. I fear you will never be able to display your own face in this way. Try what you can do with snow-drops and white [illegible]

[illegible]—**Brush Dynamo.**—Incandescent lamps must be connected up in parallel arc, as the E.M.F. of your machine would not be sufficient to burn them in series. You would not get any better result by connecting up as in Gramme's ring, if commutator is constructed of half rings as I explain. [illegible] run the machine without a sufficient resistance in circuit, or you will burn the insulation. [illegible]

[illegible]—**Brush Dynamo.**—If "Williams" [illegible] him recently, he will [illegible] He cannot connect his machine [illegible] only six coils on it. I [illegible] to put his machine on short [illegible] he will spoil the insulation. [illegible] good results without he con[illegible] lamps in parallel arc, as the [illegible] would not exceed 30 volts. [illegible] higher speed.—W. H.

[illegible]—**Intermittent Pulse.**—How does [illegible] gastric irritation ex[illegible] difficult digestion it pro[illegible] pulse is probably due to [illegible] in which the muscular [illegible] but which, for [illegible] be good enough. [illegible] medical practitioner, [illegible] confidence, and get [illegible] cause of his ailment.

[illegible]—**Intermittent Pulse.**—[illegible]

that the heart and stomach are both supplied by filaments of the pneumo-gastric nerve, and if irritation be applied to the stomach end of the nerve, it affects its cardiac (heart) end, and so may give rise to this intermittent action. He can get his stomach into order by three regular meals a day, allowing five hours between each. He must, if he uses them, give up alcohol and tobacco. At his three meals he must not have meat or fish more than once daily; or he might try the effect of a non-flesh diet for a fortnight.—T. R. Allinson, L.R.C.P.

[illegible]—**Intermittent Pulse.**—Intermittent pulse is by no means uncommon in advanced age, and is usually a symptom of little moment. I believe it is generally caused by reflex action. Irritation of the peripheral centripetal extremities of the pneumo-gastric nerve, which, as its name implies, is distributed to the mucous membrane of the lungs and stomach, stimulates the cardiac inhibitory centre in the medulla oblongata, causing it to send forth impulses by the spinal accessory nerve and the centrifugal cardiac branches of the pneumogastric, which will occasionally arrest the nominal explosive action of the intrinsic cardiac ganglia, and in this manner cause a beat to be missed. In the case [illegible] mentions I should consider that the stomach was at fault, and that it is liable to flatulent distension from muscular atony and abnormal forms of fermentation, and should recommend the use of alkalies and carminatives, or bitter tonics.—St. Bart's.

[illegible]—**Sizes of Tinplates.**—"F. G. S., Artisan," can get tin plates in quantity from Arthur Bird and Co., 18, Leadenhall-street, E.C. This ought to have been in the "Address" column; but it is impossible to answer this part of the query without giving an address.—R. A. R. Bennett.

[52266.]—**Tuning Piano.**—The covered strings are in fault: probably the under covering is of iron instead of copper wire, and, if so, their becoming "tubby" was only a question of time from the beginning. The only remedy is to put on new strings. The cost of an entire set would be about 10s., and that of the plain steel wire for the rest of the notes another 5s. Since "Amateur Tuner" seems already to have succeeded fairly well in tuning the piano, he would have no difficulty in restringing it and roughly tuning the new wires. The sizes of wire will greatly depend upon the length of strings, most likely they will be found marked upon the wrest-plank.—W. H. Davies.

[52271.]—**Lever Watch.**—Presuming that "Vulcan" carefully examined the watch and found no visible foul contact in its parts, I should be inclined to think that the cause of the watch stopping may be that the teeth of the 'scape-wheel come in contact with the "belly" of the pallet: they are not so liable to come in contact with the middle of the "belly" as at a distance from it on either side. I have found by experience that escapement makers often do not give sufficient clearance between these parts, and the result is that the watch is liable to stop, or its action to fall off in certain positions. In remedying the escapement I would always be against the practice of shifting the jewels of the lever, as, besides being a bad plan, it is also a disfigurement to the plates. Another fault I have found in the escapements of modern watches is that the balance pivots are made too small, with the object of reducing the friction to the utmost limit: but that is not at all so necessary, as the balance holes are always jewelled. A very thin balance pivot will wear away much too soon—in fact, far sooner than any other part of the watch—and it is not at all a desirable job to have a new shaft put in, at least, if it be a compensation balance, unless it be intrusted to very careful and skilful hands. As a great deal of jobbers' time is lost in trying to discover the causes of a watch stopping, it might be of service if "Vulcan" would publish the causes on which he seeks information as soon as he has found them out.—J. G.

[52273.]—**Squinting.**—To answer "Rap's" query intelligibly would require the complete discussion and explanation of one of the most complicated problems in ohpthalmology, besides more diagrams than our benevolent Editor inserts in the answers column in six months, so that I must, for brevity, speak dogmatically. The squint was undoubtedly caused by the error in refraction. In a hypermetropic eye, the eye is either unnaturally short, or the lens too flat. By accommodation, the lens is rendered more convex, and hence rays which would otherwise not meet on the retina, are brought to a focus upon it; but the accommodation cannot be exercised without convergence of the eyes—hence the squint. The refraction error is, of course, not corrected by the operation. Therefore, to prevent the return of the squint, which will undoubtedly occur otherwise, "Rup" should continually wear the weakest convex glasses with which he can see distant objects distinctly without effort or squint, be these No. 20 (2D), or No. 5 (8D).—St. Bart's.

[52276.]—**Legal.**—The answer to this query is, over £50 (32 and 33 V. c. 71, s. 87).—B. H.

[52278.]—**Gas.**—Somewhere in the back volumes "W. A. S." will find an article about his idea. It was a paper read before the Society of Arts, in which the author proposed to take all the "smoke" out of coal without reducing it altogether to coke. I believe the reason it was not taken up was because the coal left in that state breaks up too easily for handling.—Nun. Dor.

[52278.]—**Gas.**—"W. A. S." wants to suggest that our gas companies should partly distil our coal before householders are allowed to use it. It is a very good idea, but has been suggested. It would save the country a large amount of valuable products which now accumulate in our chimneys, pollute our atmosphere, cause lung disease, kill our plants and trees, make the sky hideous, and destroy our public buildings.—T. R. Allinson, L.R.C.P.

[52278.]—**Gas.**—"W.A.S." seems to have a very singular notion of the manufacture of gas and the resulting bye-products. To produce an incandescent coke we must remove all blaze and smoke, and this is done by allowing it to remain long enough in the retort to extract all its gas. Certainly there is a richer gas expelled from the coal in the early periods of carbonising, on account of the hydrocarbons being more rich in gases. The practice, however, is generally followed of obtaining the largest amount of gas possible per ton of coal, and this would largely deteriorate if the retorts were drawn (that is, the raw coke withdrawn before being fully carbonised) leaving gases *still* rich enough to mix with those evolved in the earlier period of the work. The only true method of solving the difficulty to which "W. A. S." refers—viz., "obviating the smoke from domestic fires," is to bring into practical use the principle of "flameless combustion," of which Mr. Thomas Fletcher, of Warrington, is, to my mind, the best exponent. With this principle carried out by the use of flameless gas, we see in the near future our towns and cities cleared of the noxious *fumes* and smoky chimneys which now poison *the air*, and at times make it almost insufferable. *I hope to see soon a paper in the* English Mechanic *by Mr. Fletcher on this subject, which I know would be welcomed by all.*—E. Owen.

[52279.]—**N. E. Engines.**—Mr. McDonnell has turned out a new goods engine from Darlington works, numbered 440. It is somewhat similar to L. and N. W. in type; but I am sorry to say I have not yet got dimensions. If, at any time I obtain them, I will send them. Some new bogie-express engines are, I hear, being built at Gateshead.—Meteor.

[52280.]—**L. and N.W. Engines.**—Experiment, Compound, Hydra, Knowsley, and Economist. These are fitted with Webb's vacuum brake. A compound condensing engine is also being built for the Metropolitan Railway out of one of their side tanks. A 6ft. 6in. four-coupled was in the Watford accident, not a compound.—Nomen, Liverpool.

[52280.]—**L. and N.W. Engines.**—The names and numbers of the compounds commencing with 300 are as follows: 300 Compound, 301 Economist, 302 Velocipede, 303 Hydra, 305 Trentham, 306 Knowsley, 307 Victor. The engine in the Watford collision was not one of the above, being No. 482 Pegasus, one of Mr. Webb's "Precedents."—Thunderbolt.

[52280.]—**L. and N. W. Engines.**—To "W. B. P."—The following is a list of 300 class of compounds:—No. 300 Compound, 301 Economist, 302 Velocipede, 303 Hydra, 305 Trentham, 306 Knowsley, and 307 Victor. No. 482, Pegasus, one of Mr. Webb's 6ft. 6in. 4-wheel coupled Standard Express engines, was the engine in the Watford accident, and not a Compound, as you supposed.—H. Bill.

[52280.]—**L. and N.W. Engines.**—The names and numbers of the new compound engines are:—66 Experiment, 300 Compound, 301 Economist, 302 Velocipede, 303 Hydra, 305 Trentham, 306 Knowsley, 307 Victor, 519 Shooting Star, 520 Express. No. 66 has high-pressure cylinders 11½ by 24, low-pressure cylinders 26 by 24. The other nine have low-pressure cylinders 13in. diameter, the other dimensions being the same. The two pairs of driving wheels are 6ft. 6in. diameter.—Meteor.

[52280.]—**L. and N.W. Engines.**—The engines of the 300 class are: Compound 300, Economist 301 (March 1883), Velocipede 302, Hydra 303 (April), Trentham 305, Knowsley 306, Victor 307, Shooting Star 519, and Express 520 (all July). These, with Experiment 66, are all the compounds at present at work; but I hear there are more being built at Crewe. The engine wrecked at Watford was Pegasus 482, a "Precedent," stationed at Rugby, and was a comparatively new engine, having been built in November, 1880.—W. Thompson.

[52280.]—**L. and N.W. Engines.**—300, Compound; 301, Economist; 302, Velocipede; 303, Hydra; 304, Trentham; 305, ——; 306, Knowsley; 307, Victor. The engine in the Watford accid was one of Mr. Webb's "Precedent" engines, 6ft. 6in. wheels, No. 482, Pegasus, January, 1881, stationed at Rugby. It may be interesting to some readers of the "E.M." to state that No. 300, Compound, ran from London to Carlisle, distance 300 miles, in seven hours and twenty minutes, with the 10 a.m. from Euston Station, stopped 5min. at Rugby, 7min. at Crewe, and 20min. at Preston. The speed on an average was about 42 miles per hour.—Rob Roy.

[52283.] — **Surveying Instruments.** — Has "E. M. R." seen Stanley's "Treatise on Mathematical Drawing Instruments"? The fifth edition was published in 1878 (there may be a later edition), and a notice of the book appeared in the English Mechanic on November 22nd of that year.—T. R. Saxton.

[52289.]—**Legal.**—Presuming "Gimel" refers to probate duty, and personalty, the answers will be: (1) Yes. (2) Yes. (3) Only one £3 per cent.—viz., on A.'s death. (4) On the net profit. A proper valuation must be made unless the business is sold, when its price is the sum on which probate duty is payable. (5) If property in the funds is for the benefit of the survivor eventually of two parties, the estate of the first deceased pays no duty on it, as it is no part of his property at death; the survivor, however, must pay "succession" duty on it at a rate varying with relationship to the donor. (6) Either probate, legacy, or succession duty must be paid, unless (7) A. gives away his cheque, &c., three months before his death. The Legislature is "up to the little move" proposed by "Gimel." If he leaves the property by will to his wife, she only pays probate duty; but she must pay that if testator owned the property at his death. As to the business query, the subsequent receipts cannot affect the probate duty, and the wife pays no other. The only way to avoid litigation is to say that, if the business produces so much, the widow shall receive so much, &c.; but it is impossible to provide for everything, and the attempt to cover all eventualities often, by complicating a will, insures litigation.—B. H.

[52289.]—**How to Leave my Property.**—(1) Legacies and residues, or shares of residues devolving to the husband or wife of the deceased are exempt from duty. But if A. leaves his property absolutely to his wife she will only have to pay probate duty, which for £1,000 would be £25. (2) If B. leaves the same property (or any other) to her children, probate duty as above would only be payable as by the Customs and Inland Revenue Act 1881 (44 Vic. c. 12, s. 27). The duty shall be charged on the affidavit to be required and received from the person applying for probate, the stamp duties following which for £1,000 would be £25; and by sect. 41 of the same Act: In respect of any legacy, residue, &c., payable out of or consisting of any estate or effects according to the value whereof duty shall be paid on the affidavit as above, the duty at 1 per cent. (not 3 per cent. as "Gimel" thinks it), that is, the duty payable on a legacy to a child or descendant of a child, or to a parent or lineal ancestor imposed by the Act of 55 George III. c. 184, shall not be payable. And also in respect of any succession to property according to the value whereof duty shall have been paid on the affidavit in conformity with the above Act, the duty at 1 per cent. imposed by the Succession Duty Act, 1853, shall not be payable. (3) A. ought to leave the property to his wife for life, and after her decease to be divided amongst his children in equal shares (5, 6, and 7). By 44 Vic. c. 12, s. 38, duty is now payable on certain properties, which are as follows:—(*a*) *Donationes mortis causa* (that is, property given in anticipation of death, to take effect only on death), made by a person dying on or after 1st June, 1881, or property taken by voluntary disposition, not made *bonâ-fide* three months before the death of such a person. (*b*) Property which such a person has voluntarily vested in himself and another jointly, so that the beneficial interest accrues by survivorship on his death to such other person. (*c*) Any property passing by any voluntary instrument (not being a will) whereby an interest determinable with death is reserved to the settlor, or whereby the settlor has reserved to himself the right, by the exercise of any power to reclaim the absolute interest in such property. Therefore "Gimel" will see, on reading the above, that it will be quite impossible for him to evade the duty, as the object of the 38th sect. given above is clearly to prevent the payment of probate duty being evaded by making gifts by way of *donatio mortis causa*, voluntary settlements, &c. Therefore, the best way for "Gimel," according to his intentions, which are not very plain, would be for him to make a will leaving his property to his wife for life, and after her decease to be divided amongst his children in equal shares. At the same time I most strongly recommend "Gimel" to go to some respectable solicitor to have his will legally drawn for him, as there are several little technicalities with regard to wills, which, if left undone, might altogether frustrate the wishes of "Gimel."—A Liverpool Subscriber.

[52292.]—**Problems from Newth.**—To raise 80 kilos. of snow at 10°C. to water at 0°C. we want 8 × (10 + 79) units of heat. 4 kilos of water at 60° in falling to 0°C., give out 4 × 60 units of heat. If these 240 units of heat be applied to melt snow, there must be as many pounds of snow melted as there are 89's in 240; $\frac{240}{89} = 2{\cdot}7$ nearly. Hence there will be 4 + 2·7 kilos. of water and 8 – 2·7 kilos. of snow. 6·7 and 5·3. These are far from equal. 2nd. One pound of ice requires 79 units of heat to melt it. 1lb. of lead at 327°C. contains 327 × ·0314 units of heat (above 0°C.) = 10·2678, say 10·27.

$$\begin{array}{r} 327 \\ {\cdot}3014 \\ \hline 1308 \\ 327 \\ 981 \\ \hline 10{\cdot}2678 \end{array} \;\therefore\; \frac{79}{10{\cdot}27} = 7{\cdot}69\text{lb.}$$

—J. F. Wilkinson.

[52292.]—**Problems from Newth.**—My edition of "Newth" is dated 1880, and as it seems to take a more comprehensive view than does "N. E.'s" edition, I will deal with his first question in its modified and somewhat more difficult form. In Newth's "Nat. Phil.," page 160, I read thus:—"6. If 4 kilogrammes of snow at – 10 C. be mixed with 8 kilogrammes of water at 60°, what is the resulting temperature?" "7. If in the preceding the proportions of snow and water were reversed, show that the result would be nearly equal portions of snow and water at 0°C." Now, since 4 kilos. of snow at – 10°C. require 4 × 10 = 40 units of heat to bring it to the melting point, and since it would require an additional 79 × 4 units of heat for its liquefaction, therefore the entire heat taken from the 480 units in the water would amount to 356, leaving 124 units to be divided amongst the 12 kilos of mixture; ∴ 124 / 12 = $10\frac{1}{3}$°C., which is answer to No. 6. Again, 8 kilos. of snow at — 10° would require 80 units of heat to bring it to the melting point, and since this would be abstracted from the 240 contained in the water, there would remain 160 units of heat for further diffusion, or, in this case, for the melting of the snow. Now, as every kilo. of snow would require 79 units for its solution, and as we have only 160 units at our disposal, it is clear we will only get about 2 kilos. of snow dissolved; we would then have about 6 kilos. of snow and 6 kilos. of water, or about equal portions of snow and water, at 0°C. This latter is the answer to "N. E.'s" part of the problem.—Ex-Blacksmith, Gorton Brook.

[52292.]—**Problems from Newth.**—There are, unfortunately, several errata in Newth's Chapter on Heat. To solve the questions mentioned, we must know, for the former, that the specific heat of snow is ·5, and for the latter, that the specific heat of molten lead is ·0402, neither of which is given in the book. (A) Specific heat of snow = ·5. ∴ To raise 8 kilos from – 10° to 0°, we require ·5 × 10 × 8 = 40 heat-units. Now, 4 kilos of water at 60° contain 4 × 60 = 240 heat-units, and 40 of these being required to raise the snow from – 10° to 0°, we shall have left 200, which will be expended in turning a portion of the snow into water at 0°, the 4 kilos of water also having the temperature 0°. Since 79 heat-units will melt 1 kilo of snow, we find that 200 will melt $\frac{200}{79}$ or $2\frac{42}{79}$ kilos. We shall therefore have $4 + 2\frac{42}{79} = 6\frac{42}{79}$ kilos of water, and $8 - 2\frac{42}{79} = 5\frac{37}{79}$ kilos of snow, each at 0°. If we take 80 for the latent heat of water, as given by some authorities, the numbers will be 6½ and 5½ kilos, respectively. (B) The answer given in the book is quite wrong, whether we take ·0314 or ·0402 as the specific heat of lead:

$$\begin{aligned} &\text{Let } x = \text{number of pounds required} \\ &\text{Then quantity of heat} = {\cdot}0402 \times 327\,x \text{ heat-units} \\ &\qquad\qquad = 13{\cdot}1454\;x \quad ,, \\ &\text{Quantity required to melt 1lb. of ice at } 0^\circ = 79 \;,, \\ &\therefore\quad 13{\cdot}1454\,x = 79 \\ &\qquad\therefore\quad x = \frac{79}{13{\cdot}1454} = 6{\cdot}009\text{lb.} \end{aligned}$$

Your correspondent may like to know that the answer to the question in Newth immediately preceding the former of the two given above is 12° C., not 2° C., and the answer to the question immediately preceding the latter of the two is 1·406lb., not 1·46lb.—H. C. L.

[52293.]—**Brewing.**—Multiply your produce of 520 gallons by your gravity 25·2, which will give you 13,104; then divide 13,104 by 36 will give 364lb. total extract. Then divide the total extract by $4\frac{3}{8}$ for malt used will give you exactly $83\frac{1}{5}$lb. extract per quarter.—Wm. Cook.

[52293.]—**Brewing.**—Multiply pounds per barrel by number of barrels and divide by the number of quarters. In the case you quote: 25·2 (pounds per barrel) × 14·444 (number of barrels) ÷ 4·375 (number of qrs.) = 83·197lb. extract per quarter. This is per standard quarter; of course the extract is less per bulk quarter.—W. L.

[52293.]—**Brewing.**—520 gallons = $14\frac{4}{9}$ barrels; × $25\frac{1}{5}$lb. = 364lb.; produce divided by $4\frac{3}{8}$ quarters of malt = 83·2 extract. "Ignorant Brewer" should find out what extract his sugar gives per 256lb., and subtract that from total produce, and divide remainder by qrs. malt used. Not knowing extract of sugar, I have taken 256lb. to be equal to 1qr. malt, but it only gives about 75lb. extract.—H. E. Smith.

[52296.]—**Nearest Fixed Star.**—The correspondent in the *Girl's Own Paper*, quoted by "Stellarius," seems to have made a slight mistake in the estimate of the distance of *α* Centauri. The parallax of this star has been ascertained to be nearly one second of arc, which gives its distance as more than 200,000 times that of the sun—or, taking the average distance of that luminary as 92,350,000 miles, it follows that the distance of *α* Centauri cannot be less than 18,470,000,000,000 miles.—John Willis.

[52298.]—**Bunsen Battery.**—A most convenient form of battery is the chromate, by which same position of the elements are retained, as in Bunsens, only they differ in the charging mixtures, which are as follows:—In the outer cells a saturated solution of bichromate of potash and sulphuric acid, two of the former to one of the latter, and inner cell sulphuric acid one part to six parts of water. These cells do not give off deleterious fumes, and are stronger than Bunsens, in which the fumes are very objectionable: but the latter produces a steady current in a low-resistance circuit, superior to the chromate cell. This battery is suitable for incandescent lighting and other numerous experiments where a powerful current is required. By reversing the solutions you have Fuller's battery, which is not so powerful as the ordinary bichromate, and is suitable for electric bells. The action of the former lasts only a few hours, while the latter continues in action for some months.—Electrician.

[52299.]—**Ice and Skating.**—It is safest when broken at the edges, and resting on the water. One long strap passed through the slit at the heel, over the instep, through the slit at the toe, back over the instep, and buckled on the *inside* of the foot.—T. P.

[52301.]—**Locomotive Cylinders.**—The Midland Railway Company are building some new engines with cylinders 20in. diameter, 26in. stroke. These would doubtless be the largest locomotive cylinders yet constructed, and also be about the greatest diameter admissible between the frames without making the axle or crank bearings, &c., too narrow and weak. The valves are to be above the cylinders, and driven by Joy's valve gear; the arrangement being similar to that in use in the 562 class of engine on the G. E. R. The L. and N. W. R. have built some inside cylinder engines with the valve faces arranged in > fashion to gain room. Mr. Stroudley's "Gladstone," having the valves placed underneath the cylinders, is another example of the expedients adopted to provide room for large diameter inside cylinders.—W. H. Y. T.

[52302.]—**The Cheapest Food.**—If "S. B." wants to get cheap, nourishing, and tasty food, he must go to the vegetable kingdom alone for it, and obtain it at first cost. Liebig asserts the identity of animal and vegetable fibrin, animal and vegetable albumen, and animal and vegetable casein. Food reformers and vegetarians get everything that is necessary for health, strength, and long life from the vegetable kingdom at a cost much below that got from a mixture of flesh and grains. Peas, beans, lentils, wheat, oats, barley, maize, rice, &c., contain a large proportion of nutritious matter at a small cost, whilst carrots, turnips, parsnips, potatoes, cabbage, onions, with sweet herbs and seasonings, give variety and piquancy to the food. Fresh and dried fruits make tasty dishes, and are very wholesome. Flesh foods, on the contrary, are dear in price, contain nearly 70 per cent. of water, are liable to contain many dangerous parasites, or the germs of disease. If not very fresh, they may give rise to symptoms of irritant poisoning (sickness, purging, with great depression); and if they are lived on alone, very large quantities have to be consumed. The more flesh is eaten, the more expensive is the diet. These vegetable foods are not only cheap in price, but contain more nourishment than an equal bulk or quantity of animal flesh. These vegetable bodies are so constituted as to supply to the system every element in its proper proportion. Flesh foods present us with too much nitrogen, which throws excessive work on the liver, kidneys, heart, and lungs, and they become diseased in consequence. I can say from sad experience that the beef-eating habits of our Anglo-Saxon race are the cause of the immense number of diseases we suffer from—including epilepsy, liver and kidney diseases, heart diseases, consumption, cancer, and apoplexy, besides that minor, yet terribly common, complaint, dyspepsia. These ailments mean doctors' bills, loss of time, and loss of opportunity; hence flesh foods are not cheap. If "S. B." wishes a list of cheap and wholesome foods, here they are:—Wheat, oat meal, pearl barley, hominy, rice, sago, tapio

1874-5), 6-coupled, double-framed saddle tanks, 4ft. 6in., cylinders 17 by 24; 1801—1812, single-framed saddle tanks (Wolverhampton, 1881), 4ft. 6in., cylinders 17 by 24; 1359, 4-coupled side tank, by Bristol and Exeter Company, 1876, 5ft. wheels, cylinders 17 by 24; 2201, 4-coupled passenger (Swindon, 1881), cylinders 17 by 24.—METEOR.

[52324.]—**Limited Liability.**—In a limited liability company each shareholder's liability is limited to the amount of his shares; so it will follow that if they are £1 each, and A. holds fully paid-up shares, he has no further liability; but if B. has only paid 10s. on his shares, he is still liable for a further amount of 10s. on each share, and there his liability ceases.—T. R. SAXTON.

[52328.]—**Violoncello.**—I should hardly advise "Edinburgh" to make one (without improvements) as he desires, seeing how difficult it is to do so on the old principle. No improvement is possible with the present shape, which has the soundboard moved more by reaction than directly by the vibrations. We can buy "cellos" made by machinery for 30s. that could not be made by hand under 100s. Then, unless there is something new to propose in the way of excellence in sound or power, there is no good in the attempt. One may search in all the timber yards for suitable belly wood and not find a piece. It is deal, to be sure; but it must be without a knot, yet having a straight grain throughout (not necessarily close) and also very light in weight. Three feet long, eleven inches wide, and four inches thick is worth 15s. to the wholesale dealer. The maple back, same size and seasoned, would be from 6s. to 8s. The neck, fingerboard, and furniture would cost 12s. first hand. Now here we have the materials more costly than the finished instrument, with the probability that the first move may be in the wrong direction, for these two planks must be cut lengthwise and as a feather edge, and this can only be done by a machine saw. Each divided plank has to be squared or made level to fit each thick edge, which is then glued and clamped or pressed together. The boards for soft belly and hard back lay flat on the bench, with a rise in the middle of perhaps 2¼in., but 3in. will be better. The length is from 32 to 34in., the larger width 18in., the upper width 14in. But all these sizes vary with the style of wood and thickness of strings employed. The middle thickness of soundboard or belly will be ¼in., tapering off at the *f* holes to ⅛in. Round chisels are required for shaping out the belly, and whether you have it high or low in build, the *f* holes should be made to overlap each other as the lips of a mouth, so that the air may be more vibrated than with a mere open orifice. However, I have said more than I intended, but probably enough to show an amateur that he had better leave the "cello" alone, for a great number of tools, moulds, and appliances are required for measuring, bending, and baking the sides into shape and fitting all together, with the almost certain possibility of a failure after all. When I feel sure of my experiments with the new violin without the soundpost, I will give a résumé. —FIDDLER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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51742. Induction Coil, 73.
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51761. Magneto Machine, 73.
51763. Dividing Engine, 73.
51764. L. and N. W. Locos., 74.
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52032. Leather Stains, 161.
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52049. Railway Gate, 161.
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A SHOULDER of mutton contains one-third more bone than a leg does, whilst there is also considerably more fat and connective tissue. A shoulder of mutton at 10d. is less economical than a leg of mutton at 1s. a lb. To make their values at all equivalent, the shoulder should be sold at 8½d.

QUERIES.

[52329.]—**Electrometer of Small Resistance**—I want to find an electrometer to note very feeble currents. Lippmann's capillary electrometer appears to me the most suitable: but I shall feel much obliged if "Sigma" will tell me if this is so, or if any other kind will be practically better? The electrometer will never have to indicate more than feeble currents.—BATTERY BALANCE.

[52330.]—**Equatorial Circles.**—My telescope moves much more stiffly on the circles than it did, and the hour circle itself is the same when I turn it. How can I oil them, or what should I do to remedy it?—M. A.

[52331.]—**Varnish for Baywood Tops of Carding Engine.**—Will any of your readers kindly inform me of a varnish for varnishing the tops (baywood) of carding engine? I have tried several sorts, but they all go dull in the course of about an hour.—T. T.

[52332.]—**Screwpitch Striker.**—I believe a tool is made by which the correct pitch of any screw may be traced by hand. Will anyone who possess one, kindly describe the mechanism of it?—OUVRIER.

[52333.]—**Legal.**—A man obtains an absolute divorce from his wife. Are the children of their marriage, being of age, liable for the maintenance of their mother; or is there any responsibility on their part towards her? She is an invalid.—SEMAPHORE.

[52334.]—**Draughty Church.**—Will any of your readers please inform me if their exists any means of curing the draught in a church? The church is warmed by a hot-water apparatus with saddle boiler, the pipes being laid in trenches in the centre of the nave and aisles. The congregation complain of a draught apparently coming down on their heads. On holding a candle near the walls, especially in the angles, a very strong down-draught is perceptible. The roof is a timbered one, the slates laid on felt, and there is no visible aperture. Who is the best authority on this subject?—CHURCHWARDEN.

[52335.]—**Lacquering Brasswork.**—Will some kind practical hand assist me? Is it possible to copper bronze brasswork properly without battery power?—also a recipe for good black bronze and the right lacquers to use for red bronze and steel bronze? I have tried numbers of recipes that have been published in the "E. M." for years past, but have failed to obtain good results. I can lacquer very fairly when I can get good materials.—OLD SUBSCRIBER.

[52336.]—**Test for Cane Sugar.**—Would Mr. Allen or any other chemist give a method of distinguishing crystals of cane from beetroot sugar? Chemical or microscopical.—H. C. M.

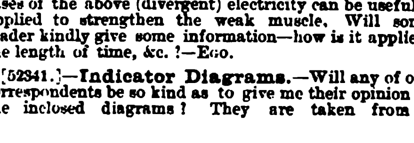
[52337.]—**Telescope O G.**—I have a 4in. telescope with pretty good both defining and light-grasping power, but find after having focussed with low power and then putting in a high power, that it requires to be screwed outwards to focus under this power. Would "F.R.A S." or other astronomical friend kindly explain this?—R. S.

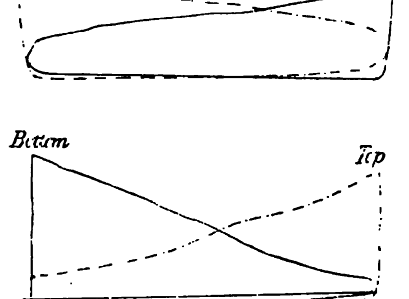
[52338.]—**Holtz Machine.**—Would any kind reader answer the following questions with reference to stationary plate of above? (1) Would it do to be cut across where the holes are to be (thus making it easier to cut the holes) and cementing it together after they are cut out? (2) If the above would not do, how would I cut the holes out? (3) Would it do to have the revolving plate of glass and the stationary one of vulcanite?—AMATEUR.

[52339.]—**Brazing on Ends to Muntz Metal Boiler Tubes.**—I should feel obliged if "Nun. Dor." or some other reader would kindly give some informa- as to how I am to do this. Tried forge fire and failed. Could it be done with a blowpipe? Or if it can be done with a forge fire, How? On a forge fire I find it burns the tube before spelter melts.—Y. Z.

[52340.]—**Strabismus.**—I have heard that in slight cases of the above (divergent) electricity can be usefully applied to strengthen the weak muscle. Will some reader kindly give some information—how is it applied, the length of time, &c.?—EGO.

[52341.]—**Indicator Diagrams.**—Will any of our correspondents be so kind as to give me their opinion of the inclosed diagrams? They are taken from a McNaught's beam-engine, with McNaught's (gridiron) expansion valve regulated by the governors. The engine is not so heavily loaded as it was previously. Consequently, I have to throttle the steam, that is not let the full boiler pressure on, which is on an average of 48lb. per sq. in., as the governors have not the same control over the engine. The diagrams are not so good as they were a few months since, as the point of cut-off is not distinct, as will be seen. P.S.—Diameter h.p. 33in., stroke 3ft.; l.p. 36in., stroke 6ft.; 32½ revolutions per min.—W. F.

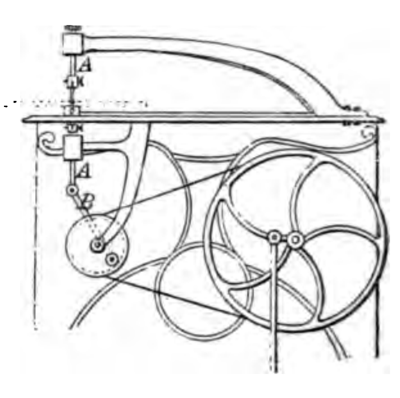




[52342.]—**Siemens Armature.**—Would any of our readers kindly tell me the best size wire, and number of layers, for winding a Siemens armature (H pattern)? It is 10in. long and 3½in. diam. It is proposed to wind the F.M. with No. 16, but am uncertain as to size of wire for armature. Any information will be gladly accepted by—WAG.

[52343.]—**Electric Light.**—To "SIGMA" AND OTHERS.—May I ask a valued reply to the following?—(1) Five granular carbon cells are supposed to light one of Swan's 5c p. incandescent lamps. (*a*) If I use six or even seven cells, will it be detrimental to fittings—as wires, &c.,—and (*b*) if not, could I obtain good reliable light? (2) Lamp to burn 6 hours per night, approximate renewals of acids, &c? (3) Could I regulate power of lamp by using, say, three cells for one hour, when little light was wanted, then join other cells on when required, and get full power of lamp?—INCOGNITA.

[52344.]—**Fretsaw.**—This is a rough sketch of a fretsawing machine I am constructing (or rather trying to construct), which so far explains itself. I find that a spiral spring from the top, of strength enough to stretch the saw very tightly, will not allow the small wheel to go round properly. What could I do to remedy this, or what could I have in its place? Should the working parts A A and B be of steel, or will iron do? I find these make a great noise. What is the remedy for this? How could I affix an efficient dust-blower to be worked by the driving-wheel?—A DECIDED AMATEUR.



[52345.]—**Non-Condensing Horizontal Engine.**—Having bought at a sale a new horizontal non-condensing steam-engine, I should esteem it a favour to receive from some of our practical correspondents a statement of the indicated horse-power which this engine will develop? Also, what is the nominal horse-power of this engine? Following are particulars:—Cylinder: diam. 16in., stroke 42in., 80 revs. per minute; steam pressure as indicated by boiler gauge 65lb.; steam on ⅛ of stroke; piston-rod 3in. diam.; the exhaust will be allowed to fly away and not be confined at all.—YOUNG MANUFACTURER.

[52346.]—**Developing Box.**—I am desirous of making a portable dark tent or box for developing and changing 6½ by 4¾ dry plates, suitable for travelling work. I shall be much obliged if some of your readers will help me by giving dimensions, &c.: one that would not necessitate working under a cover preferred, on account of heat of climate.—PHOTO.

[52347.]—**Vacuum Gauge.**—Our condensing engine (air pump 18in. diam., 4ft. stroke) has had a Bourdon patent vacuum gauge fixed on the condenser, and when the engine is working full speed the gauge shows the vacuum pointer at 25. Is this right, or would 10ft. of ¼in. tubing, which is between the gauge and condenser, make the difference, as we did not expect the pointer going higher than 15 or 18? The engine cylinder is 25in., with 5ft. stroke; boiler pressure 40lb. If "Labor Omnia Vincit" or "Boswell" will give their opinion it would oblige.—BAD VACUUM.

[52348.]—**Boiler Tank.**—We have a boiler for tank which is 22ft. long, 7ft. diam., with a tube 2ft. 6in. dia. through the centre (the tube contains no water, of course). Will some better scholar than I tell me how many gallons of water the tank will hold, and what would be about the weight?—BAD VACUUM.

[52349.]—**Steam Mill Pump.**—Will any of your kind readers instruct me in the following? My mill pump that I use in the brickyard has been blown down. How can I proceed to work it by steam, and what amount of power shall I want to work it? It is a 5in. barrel pump. Please say what size pulley I shall require, and what is the shortest length of rod it should have? The pump is rather high, and I should like to keep the steam gear as low as possible. Some general information on the subject will be thankfully received by—NARVA.

[52350.]—**Legal.**—A. mortgages property to B. for £500. Two years after A. makes second mortgage to C. for £100. A. gives B. notice of his intention to do so. Soon after A. neglects to pay interest to mortgagee. In consequence, B. gets writ of ejectment and turns A. out of the property. Within a week B. offers the property for sale by auction; but not finding a purchaser, sells it shortly after by private treaty for £550. Now B. has never given any notice to C. of his intention to sell, or to A. either; neither has B. rendered any account to C. or A. of the sale. What is C.'s remedy to recover his money, and is B. justified in selling at what price he likes, the property being worth much more?—SECOND MORTGAGEE.

[52351.]—**Waterwheel.**—I should very much like to have the opinion of some of your able contributors on the above. D is the wheel, 20in. diam. and 1in. thick, having buckets formed on its periphery a, a, a, &c., 4in.

deep, 1½in. long, and ¾in. broad, thereby leaving ⅛in. on each side of bucket so as to form said bucket. These buckets are deepest at *d*, and gradually shallow till they become nothing at *e* (Fig. 1). At *b* (Fig. 2) water enters under a pressure of 6 lb. to the sq. inch at an angle of 30°, that is in the direction from *e* to *d* (Fig. 1). Under this force wheel would revolve; but I find that the water escapes between revolving wheel and *c c*, as at *z z* (*g g*, parts of *c c*, are close up to, but not touching, wheel, but are not so in drawing to aid description). Of course, if I jammed wheel up against *c c*, I might be able

Fig. 1.

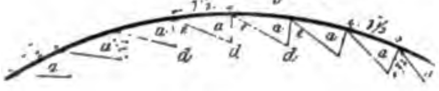
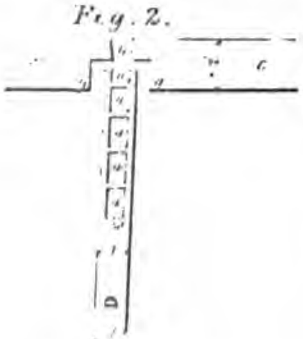


Fig. 2.



to stop water from spurting out all over the place; but then the wheel could not turn because of the friction produced by such a procedure. What is the best to do under circumstances? let it run on now like it is doing, wasting [illegible] more water than it would do if it were watertight? But the fun of it is, being in town, I have to pay for all the water it consumes by meter. Couldn't any kind reader affect a remedy? Would india-rubber [illegible] periphery of wheel and also round water pipe? What is it they have round piston of a steam-engine? Would that do? Would not water perish it? for I am not using it always, say three or four times a week. Would it get dry in interim and crack? Any hints will be received with thanks by MELBOURNE.

[illegible] **Orchestral Concerts.** The concert season is now beginning. Could any correspondent kindly give a description of the various instruments employed, their special qualities, and any scientific phenomena that one might endeavour to trace during the performance? [illegible]

[illegible] **Legal.** A. died ten years ago, leaving a widow but no children, and by will bequeathed his estate (which consisted of money) as follows: To his brothers and sisters he gave one half, divided equally amongst them, and the other half to his widow, absolutely. If the widow dies intestate, who will have the [illegible] of the house and the funeral, and [illegible] of [illegible] furniture and money)? Will the [illegible] of A. or the nearest relative of widow? She [illegible] nephews and nieces residing [illegible] of A.'s executors is dead, but the other [illegible] is living.—A 14 YEARS' READER.

[illegible] **Gelatine Transparencies.** —I am [illegible] "Wyndell's" more complete description [illegible] Will he oblige me by giving directions for making gelatine transparencies for the lantern [illegible], which he is, I believe, well up?—GLATTON.

[illegible] **Oxidising Silver.** —Would some one inform me how to oxidise sterling silver? I have tried many ways, but it will not stick on. The best way I find is to use sulphate of potash, but a friend told me that a new way has been discovered lately.—E. H., Birmingham.

[illegible] **Watch License.** —Is it needful for the [illegible] with the right of selling watches [illegible] for a firm, to obtain a license, or is the license the firm holds sufficient?—DR. FRANCIS.

[illegible] **Melting Solder on Brooches.** —I have [illegible] been endeavouring to melt the solder [illegible], with the blowpipe, but have not been able to do so. Is it because the flame of a candle which I have been using is not sufficient, or is it that I have not applied the flame properly?—W. J. L.

[illegible] **Portishead Tunnel.** —Can any of your correspondents give me any glimmering of an idea when the Portishead tunnel is likely to be finished and working? I have occasionally to make the long journey between Midford and London, and have for years been looking forward to the hour's saving of time to be effected when the tunnel is completed. But the years come and go, and the only time the tunnel appears in the newspapers is when there is an accident there.—F. B. H.

[illegible] **Medical.** —Will Dr. Allinson or Dr. Edmunds give me their opinion upon the following case? The child of a labouring man, between three and four years of age, whose eyesight was perfectly good until three weeks ago, has suddenly, in a few days, entirely lost his eyesight. There is no apparent reason for this, as the child has not met with any accident, is perfectly well in health, and does not complain of any pain. It does not appear to proceed from the brain, as there are no headaches, and the child is unusually sharp and intelligent. Moreover, his eyes are quite bright, clear, and full of expression, so that no one could imagine anything to be amiss with them. The child has never made the least remark upon his loss of vision. Is it possible that it is not dark to him?—that he can see the light without being able to distinguish anything else? One curious fact is that since the affection of the eyes the child has never shed any tears, though he has cried several times. Does such a case of sudden and entire loss of eyesight often occur?—and is it possible that his vision will return as suddenly as it was lost? An early answer will much oblige.—R. A. B. BENNETT.

[52360.]—**Integrals.**—How are the integrals of—

$$\frac{dx}{x+\sqrt{(x^2-1)}} = \frac{x^2}{2} - \frac{x\sqrt{(x^2-1)}}{2} + \tfrac{1}{2}\log.\,[x+\sqrt{(x^2-1)}],$$

and

$$\int_0^{2a}\sqrt{(2\,a\,x-x^2)}\,dx = \frac{\pi a^2}{2}\ \text{obtained ?}$$

—INT. CAL.

[52361.]—**Equation.**—I should be much obliged if some reader would give the solution of the following equation :—

$$y\,W\sec.\,\theta = S\,C\,\frac{\left(1+\frac{d^2y}{dx^2}\right)^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$$

and obtain the value of C.—EQUATION.

[52362.]—**Engineering.**—Will "Dubliniensis," or any of "ours," kindly answer the following queries, and give mode of working? (1) What will be the angle of the thread of a screw which is 2·756in. diam., and has a 5in. pitch? (2) Taking an engine and boiler which require 2lb. of coal for every indicated or actual horse-power developed, what percentage of useful effect does this give, taking the mechanical equivalent of heat at 772 ft.-lb., and the coal as yielding 12,000 units of heat per pound?—SILEX.

[52363.]—**Discharge of Water.**—I am desirous to know what quantity of water will be discharged in an hour from a lead pipe 1in. in diam., served at right angles from a 4in. main pipe which has a head of water 50ft. high, and runs a distance of 150 yards. If any kind reader would work this out for me, I shall feel obliged.—S. B. D.

[52364.] **Salamander Crucibles.** — Will Mr. Fletcher, or some other reader, kindly give his experience of salamander crucibles? I find that a 4 by 3in. crucible, after 45 minutes' exposure, to a white heat in a blast furnace (coke and cinders), becomes almost useless; the outside and inside covered with globules of brown enamel, and the substance of crucible so soft as to be easily scraped away with a nail, and resembling granulated blacklead in colour and consistence. When the crucible is white hot it is so soft as to be easily crushed out of shape by the tongs, or disrupted if pinched by one side. The same thing occurs if the crucibles are heated in an ordinary forge. The "Salamander" brand certainly do not crack up on first heating; but I cannot understand their disintegrating so rapidly. My experiments were with copper, and salt was the flux used. Was this wrong? If so, what flux should have been used? It would not appear to me that the flux was the cause of the above condition, as both inside and outside of the crucible were similarly affected. The bottom of the crucible was not injured where it rested on a fireclay shelf in the furnace. This was the only portion which stood well. The furnace was lined with the mixture of fireclay and sawdust, recommended by Mr. Fletcher in his work on Metallurgy.—R. W. F.

[52365.] **Photographs.**—I should be much obliged if some one will tell me whether ordinary mounted prints harm by being varnished, for if not, varnishing would be a cheap substitute for glazing for frames, &c., where prints are exposed to the air and light, and please state best varnish for same.—WYNFELL.

[52366.]—**Skates.**—Can any of your correspondents inform me whether skates made of a plane hoop of steel shaped like a capital C, with plates for the toe and heel of the boot, are good? I have seen some of this shape, which looked to be very easily adjusted.—ARVAS.

[52367.]—**H.P. of Engine.**—Will any reader tell me the horse-power of my engine (high-pressure beam)? Stroke 6ft. 3in.; diam. of cyl. 28in., piston making 24 strokes per min.; pressure of steam 40lb., as indicated on gauge in engine-room; steam ports 15in. by 2in.; exhaust 15in. by 4in.—IGNORAMUS.

[52368.]—**Red and Blue Photographs.**—Many years ago there was a description of how to make these in *Cassell's Monthly*. I cannot now lay hands on the copy. Perhaps some reader of the "E. M." knows how to make them and would describe the operation? I believe the chemicals for sensitising were bichromate of potash and ferrocyanide of potassium; but I cannot remember either the quantities or the process, or how to fix the photographs.—I. O. U.

[52369.] **Squeaking in Musical Box.**—Can any one give me information how to prevent the squeaking of notes in a long-barrelled musical-box? The squeaking is all in the bass. One or two check-springs are off, but there is no jarring. I have tried pitching of notes and other attempts, but to no success. Should check-spring touch the notes or not?—AMATEUR.

[52370.]—**Dynamo.**—Would Mr. Lancaster, or some reader, kindly say how the amount of wire and size is calculated or arranged for the armature and field-magnets of a dynamo? I am about trying a new armature, but do not know how much wire to put on it, or the size. There must be some rule by which dynamo-makers go.—THOMAS PLUNKETT.

[52371.]—**Gem Lenses.**—I have nine of these all screwed into a brass plate, and I want to know how to make a camera suitable for them. Must each lens have a small box or compartment for itself, so that the light from each falling on the sensitised plate may not confuse or weaken each image, or is this refinement necessary? I will be glad of a few hints on this subject, and I would also like to know if these little lenses may be used to take reduced or microscopic transparencies.—A GEM.

[52372.]—**Chemical.**—I shall be glad if Mr. Allen, or other experts, will favour me with an explanation of the following reaction:—If a solution of chloride of [illegible] be mixed with a solution of chloride of lime (hypochlorite of lime), a precipitate is thrown down. What is the precipitate, and is it possible to cause the two compounds to remain in solution, or are they incompatible? As an oxidising agent, which is the most powerful—permanganate of potash or bichromate of potash? and give the equations.—ANALYST.

[52373.]—**Polishing Brass.** — Can any of our mechanical friends oblige with a few hints as to what kind of inexpensive machine I could rig up to polish plates in brass 6ft. long by 6in. broad, generally flat? At present we pumice-stone and polish them by hand, but the labour is so great I would like if mechanical means could be devised to accomplish the same.—JIM.

[52374.]—**Pump.**—Would P. J. Davies, or some other friend, kindly answer the following questions?—It is desired to fix a small hand pump on to sink so as to supply a cottage with water; but the well is 8ft. distant from the cottage, and the water usually rises to within about 6 to 8ft. from top of well. Now will there be any difficulty in raising the water and carrying it so far by an ordinary lift pump? Also what size feed-pipe would it require to supply a 3in. pump efficiently?—PUMP [illegible].

[52375.]—**Gramme Armature.**—Can any of our [illegible] tell me what thickness the ring or armature ought to be? The armature, when coiled with four layers of No. [illegible] c.c. wire will be 5in. in diam. Also the best way to insulate the wire?—RING ARMATURE.

[52376.]—**Removing Varnish from Oak Panelling.**—Could you inform me of the best way to remove a coating of silicate of soda from some oak panelling? It was intended as a varnish, but having effloresced and broken up into flakes, I wish to get it off without injuring the wood.—METEORITE.

[52377.]—**Chemical Problem.**—Would any of ours kindly show me the method of working the following problem :—

The heat of combination of potassium chloride (KCl) having given—

$(K_2O, Ag) = 164560 \qquad HCl, Ag = 39320$

$(H_2O) = 68360 \qquad KCl, Ag = 4440$

$(HCl, Ag, KOH, Ag) = 13700$

—PHONO.

[52378.]—**Chemical Problem.**—Would any one also kindly show me the method of working the following :—

Find the heat of formation of methane (C_2H_4), having given—

$(C\ [\text{amorphous}]\ O_2) = 96960 \qquad (H_2O) = 68360$

$(CH_4, O_4) = 213530$

—PHONO.

[52379.]—**Banjo.**—I have recently bought a banjo, and I am now every evening leathering away with a vehemence which at least expresses my desire to excel in serenade. But I wish to ask my "E. M." friends how I can render the music more brilliant and less tubby. If I strain the vellum more and use thinner strings, will I succeed? *Or is there any gain in oiling* the vellum? Should *the fifth long string be covered* with wire, like a fourth fiddlestring. *A few hints on the* management of the instrument would be thankfully appropriated by—A. LUNATICK.

[52380.]—**Wells' Altimeter.** — Living in close proximity to several mountains, peaks, &c., am desirous of measuring the altitude. How can I make this or "Glatton's" useful for the purpose, as some mountains are probably 1,600ft. high, and I am unable to perceive how I can use either altimeter for so high an object.—PENMAENMAWR.

[52381.]—**Legal—Power of Local Board in Water Supply.**—I am 800 yards from end of water main which is here belonging to the local board. As I am requiring a constant supply for trade and domestic purposes, I wish to know if I can compel them to supply me with water if I am willing to lay all the pipes; or can they refuse me permission to put the pipes down, myself bearing the whole expenses, and I offer them a rental on the water used? Or can I lay the main and then demand supply of water.—WATER.

[52382.]—**Plaster or Cement for Outside Walls.**—The outside covering of my house, which seems to be composed of some sort of clay, is continually dropping off in large flakes. I think of stripping it all off; but before doing so, shall be much obliged if some reader will kindly tell me what to recover it with (not too expensive). The framework of house is wood.—S. B.

[52383.]—**Crumpets.**—I think there was a recipe for these some time ago, but can't find it. Will some reader kindly give me full instructions for making and baking?—S. B.

[52384.]—**Absorbent Cotton Wool.**—I have some white cotton wool which is very absorbent, and has a snowy feeling when pressed by the fingers, and it does not show alkali or acid when tested by the testing paper. Can any one inform me what process it goes through to make it as above?—STUDENT.

[52385.]—**Argelander's Star Chart.**—This question was asked by me on p. 46, but I have had no reply. I shall be very much obliged to any one who can give me the information. Are the Durchmusterung and the Bonn Catalogue the same? What other maps and catalogues of Argelander's are there? I want to get his chart which gives the stars on a scale of four minutes of R.A. by one degree of D; but I do not know which is. Is there a catalogue to go with it, giving places and names of the stars?—BRICKWALL.

[52386.]—**German Mouldings.**—I have some of the above, which appear to have had a coating of tin and then lacquered. Could any one tell me how this is done? Any information would oblige.—B. B.

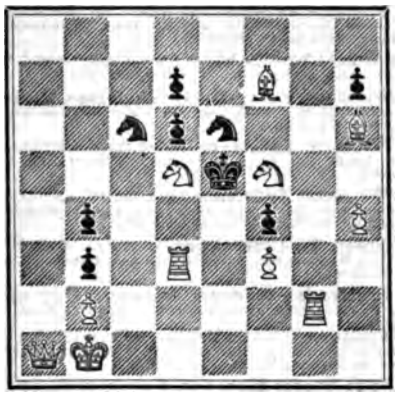
[52387.]—**Bending Brass.**—Can any of the readers of ours suggest a method of bending strips of brass 6ft. long, by No. 12 wire gauge, into an ogee 9in. by [illegible] I have a number of such to make for a shop-front, and find a difficulty in bending them straight and regular in shape.—JIM.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXIII.—By C. R. Baxter (from "Chess Problems.")

Black.



White. [11+9

White to play and mate in three moves.

Solution to 861.

White.	*Black.*
1. R-Q 4	2. Anything
2. Q, B or Kt mates	

(Five variations.)

NOTICES TO CORRESPONDENTS.

Correct Solutions to 859 by G. Seymour Follwell (good problem: sacrifice of R and Q piquant); to 860 by Dicky Sam (splendid, and well merits its title); to 861 by Schmucke and Rev. W. Anderson.

R. A. Bennett.—There is no mate if 1. $\dfrac{\qquad}{\text{Kt-Q B 5.}}$

C. Planck.—Thanks for the very neat prob'em.

H. B. Reynolds, Jr.—Game duly received.

English Mechanic Tourney game between Mr. J. Russell (*White*) and Mr. J. H. Blake (*Black*) :—

(Ruy Lopez.)

1. P-K 4, P-K 4/2. Kt-K B 3, Kt-Q B 3/3. B-Kt 5, P-Q R 3/4. B-R 4, Kt-B 3/5. P-Q 3, B-B 4/6. P-B 3, P-Q Kt 4/7. B-Kt 3, P-Q 3/8. B-Kt 5, Castles/9. Castles, B-K 3/10. B-B 2, B-Kt 3/11. P-Q 4, B-Kt 5/12. P-Q 5, Kt-K 2/13. B takes Kt; P takes B/14. P-K R 3, B-Q 2/15. Kt-R 4, K-R sq/16. Kt-B 5 (*a*), R-K Kt sq/17. Q-B 3, Kt-Kt 3/18. P-K Kt 3, B takes Kt/19. P takes B, Kt-R 5/20. Q-Q 3, P-K 5/21. Q takes K P, R takes P (ch)/22. K-R 2, R-Kt 7 (ch)/23. K-R sq, R takes P (*b*)/24. R takes R, B takes R/25. Q-K B 4, B-K 3/26. Kt-Q 2, Q-K Kt sq/27. B-K 4, Q-Kt 6/28. Q takes Q, B takes Q/29. R-K B sq (*c*), R-K sq/30. K-Kt sq, K-Kt 2/31. K-R sq, K-R 3 (*d*)/32. R-K Kt sq, B-B 5/33. R-Kt 4, B-Kt 4/34. Kt-B sq, R-K 4/35. Kt-Kt 3, K-Kt 2/36. P-Kt 3, K-B sq/37. P-B 4, P-Kt 5/38. K-R 2, P-Q R 4/39. K-R sq, P-K R 4 (*e*)/40. Kt takes P, Kt takes P/41. B takes Kt, R takes B/42. R-Kt 2, B-R 5/43. Kt-Kt 3, R-B 6/44. K-R 2, P-K B 4/45. Kt-K 2, P-B 5/46. Kt-Q 4, R-Q 6/47. Kt-B 5, P-B 6/48. R-Kt 4, R-Q 7 (ch)/49. K-R sq, B-B 3/50. P-K R 4, R takes R P/51. Resigns.

Notes by Mr. Blake.

(*a*) Q-B 3 first is better.
(*b*) If $\dfrac{\qquad}{\text{B takes P}}$ White will be able to extricate himself by 24. $\dfrac{\text{Kt-Q 2}}{\text{Q-K Kt sq}}$ 25. $\dfrac{\text{R takes B}}{\text{R takes R}}$ 26. $\dfrac{\text{R-K Kt sq}}{\qquad}$
(*c*) There is nothing better.
(*d*) Loss of time. K-B sq at once is the correct play.
(*e*) This combination wins. Black has had it on the board for two moves past; but it was advisable to have the Q side P's advanced as far as possible before entering on it, and there was also the possibility of White's attempting to bring his K across, in which case Black would win much more quickly even than now.

White Fire.—A white fire which can be used as an artificial light in photography, is composed of chlorate of potash eight parts, sulphide of antimony four parts, sulphur two parts, magnesia in fine filings, or powder two parts. The ingredients must be powdered separately, and then mixed intimately with a bone spatula.

A Perpetual Clock.—A clock was set going at Brussels some months ago which continued to go for nine months, and had not run down when last heard of. An up-draught is obtained in a shaft by exposing it to the sun; this draught turns a fan, which winds up the weight of the clock until it reaches the top. It then works a brake which stops the fan until the weight has gone done a little, when the fan is free *to recommence.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 28, and unacknowledged elsewhere :—

L. Wray, jun.—T. B. Etty.—J. C. Montgomery.—Capt. Lister Kaye.—A. Norfolk.—A. J. Herbert.—Barnett, Foster, and Co.—E. A. Litton.—E. R. Morris.—J. D. Morrison.—H. Gnidrah.—W. Jones.—Orion.—H. J. Sayer.—Chemical.—A J. Walter.—W. H. Richmond. An Apprentice.—A Watchmaker.—G. C. D.—S. R. Bottone.—Orderic Vital.

H. (For hard and soft soldering, see pp. 170, 264, 334, 455, Vol. XXXIII., and the indices of that and many other back volumes.)—Talc. (For gilding, see many references in the indices; but an inexperienced person will scarcely succeed the first time.)—Fred. Wright. (Gas lighting by electricity has been frequently described. See p. 391, No. 927, or p. 472, No. 905.)—Joe. (If of ivory, the aniline dyes will do; but they quickly fade. Many recipes in back numbers. For black, immerse in a strong boiling decoction of logwood for about five minutes, and then place in a solution of sulphate of iron. For red, immerse in a solution of cochineal in ammonia. In both cases the ivory must be thoroughly cleaned with strong solution of washing soda, and in the case of the red dye soaked for a few minutes in water made acid to the taste by aquafortis.)—Simplex. (You should read the laws of magnetism, given in the textbooks. The proportions for electro-magnets which have been found best, and which are generally used by makers, were given in Vol. XXXIV. p. 336. Your dimensions will probably lift 50lb.; but 24 wire is rather fine. A good deal about Altandi magnets in back volumes—see pp. 350, 386, Vol. XXXIII., for instance.)—Bernard. (We do not know; but believe they can be obtained at South Kensington or of Chapman and Hall, Piccadilly. Any science master could tell you.)—Edward S. E. G. (Brailsford's bell and indicator was illustrated and described in No. 947. Similarly, you will find all that can be usefully said about the other query on pp. 456 and 482, Vol. XXXVI.)—Tyro. (A collection of good lead pencils, a piece of rubber, and a sketching block. Such a question would be answered by any dealer in artists' materials.)—W. Coats. (Answered many times. See, for instance, p. 334, Vol. XXXII., or p. 456, Vol. XXXIV.)—Les Dents. (The following extract from index to Vol. XXIV. may help you :—Feathers: cleaning, 466, 489; curing, 294; dyeing ostrich, 22; how to curl, 417, 439.)—Listener. (There is no way of preventing it and keeping the tubes efficient; but a curtain over the end might be sufficient to prevent the words being heard without interfering with the whistle.)—Leather. (There are several recipes in back volumes; and you can make the one which will suit your business best. Crude fish oil, tallow, and rosin is the composition used by curriers; but there are other materials which you might be able to obtain more readily.)—George Broadbent. (Grind up any desired pigment with gum water. Add a little sugar if you like, or use any coloured ink, adding solution of gum arabic or gum tragacanth.)—Mark. (You will have seen that we mention the matter on p. 263, last week. The cost is £7—that is, 35 dollars—but practically you must employ an agent, unless you take a trip to Washington.)—Electrical. (We do not know why it should not. Suppose you try the experiment with millboard, for instance. Probably you will find it as costly as glass.)—Harmonograph. (Can be seen at most makers of scientific instruments. 2. Any ordinary arrangement of mainspring and fan will do to rotate the table. See pp. 18, 93, 188, Vol. XXV., for details of the whole instrument. 3. As to this question, see the answer to "Electrical," preceding.)—Enquirer. (The directions are given in most works on chemistry. It is extremely risky for anyone not skilled in chemical manipulation to prepare it, and any one sufficiently skilled will know where to find the recipe.)—H. D. (Yes, it is quite true; but what has it to do with the resolving power of the microscope?)—Hoinos. (There are several slide-rules in the market, and you will find answers to your questions in the last two volumes. We thought the subject had been pretty well exhausted.)—E. M. E. (Extremely unlikely; but you will have seen what has been said on p. 129, this volume, and in Dr. Edmunds's papers previously.)—A. J. D. (Both queries have been answered many times. We cannot in the case of questions so indefinite do more than refer to the list of Back Numbers, given in this column the first number in each month.)—Jimmy. (Crewe or Derby would be better places. The work is hard, and wages from 12s. to 18s.)—Eyesight. (Better consult a surgeon at one of the eye hospitals, and in future use spectacles of dark glass or look at the arc through a piece of dark green glass.)—R. H. S. (It is a case for examining the instruments and their connections. No one can suggest a remedy on the bare recital of the defects you mention. Most likely the distance of the magnets is not properly adjusted.)—H. O. (The "Grammar of Lithography," Wyman and Sons, Great Queen-street, W.C., and several books on wood engraving. See the catalogue published by Mr. Calvert, Great Jackson-street, Manchester.)—C. R. K. (The time varies. See many articles in back numbers. Most likely the artist you refer to used a different process.)—Typographia. (Try the effect of some lime in the water. 2. The numbers can be obtained only by advertising for them.)—Xmas. (A recipe is given in most cookery books. Brandy is the usual thing added, with noyeau, or other liqueur to taste.)—D. W. (Has been given many times. If of ordinary steel, heat to a cherry red, cool in salt and water, file bright, and put on a hot iron until blue; then quench.)—W. D. L. (See previous answer. 2. Yes, the lid must be luted on. 3. More; the pulley block is the easiest, because speed is converted into power.)—Mechanic. (There is no special recipe; it is simply the usual method of hardening and tempering; but if you refer to p. 320, No. 741, you will find all about hammering them as well. Briefly, the recipe is, heat to a dull red and cool in water. The art of doing it properly can be learned only by practical experience.)—G. D. A. (We gave one on p. 81; but it is doubtful if you will find a permanent polish to remain pliable unless it undergoes the japanning process. 2. They must be relacquered. 3. For bronzing brass, see p. 13, Vol. XXXV., and the indices generally.)—J. (Consult the catalogues of the music sellers. 2. Just as much difference of opinion about the pegs as about the books.)—Student. (See p. 505, Vol. XXXI., and the indices generally.)—A. M. (We scarcely understand you; there is only one way to file them up.)—Electroplate. (If you cannot read up the subject in back volumes you may get some hints as to the first and third questions from the catalogue of the Elmore Co., Blackfriars-road, S.E. 2. For burnishing, see p. 171, Vol. XXX.; p. 169, Vol. XXXV.; and many other places in back volumes. For many hints on nickel-plating, see p. 489, Vol. XXXIV.)—T. J. Milner. (The only difference is that it is done a little easier when the loose leg is rested on a table. Try it, taking hold of the handle, but mind which leg you rest on the table. No magnetism is required. If you had devoted five minutes to trying the experiment, we should think you would have found it out. As many seconds would suffice for most people.)—Jno. H. Milne. (About equal parts, from the size of a pea or less; but the fine dust must be sifted out. You should learn the principles. A number of small cells coupled in series will give the E.M.F. of one multiplied by the number; but the internal resistance will be greater than with one large cell. The E.M.F. of a cell properly made and charged is about 1·5 volt.; but the battery is suited only for intermittent work, such as bell ringing. 2. We cannot possibly determine which articles you refer to; but you will find a list of back numbers often asked for at the top of this column the first number in each month.)—J. D. M. (How could the brake mentioned have as many "failures," when it is used only as an "emergency," and must be tried before it can be found to be out of order? The nature of these "failures" has been explained before, and all railway men are quite conversant with them.)—Anti-putty. (The simplest method is to hold the pieces down by driving in a few brads; but the best plan is to screw fillets on the bars or to use rolled strips of zinc.)—H. J. C. (Something depends on what you mean by "engineering"; but, at any rate, the only way to obtain employment is to seek of those who have the power to give it.)—H. B. (Is not a description given in their catalogue? We do not know the engine by that name.)—Schiox. (You want a gas burner taking its supply from the room and discharging into the air. This burner is made to heat a pipe by which fresh air is led into the room. If you can get a supply of warm air from any other source that would be better still. You will find several ideas in back numbers.)—J. G. B. (If he stood on an insulated surface and you did not, would that explain it?)—E. T. Brydges. (We have already done so in back volumes. The machine named is the best; but you will find some accounts of their economy in recent numbers.)—Darkness. (It is used for the purposes named, and also for steel and iron making. If you advertised that you had quantities for sale, you would, no doubt, soon find customers.)—Retlaw Repooh. (Several queries of the kind have been inserted, the general result being that no one had a good word to say for them. Surely you can obtain gas.)—T. T. (We believe you can obtain just the information you require from the Secretary of the Pharmaceutical Society, Bloomsbury-square, W.C.)—Electron. (The question has been answered frequently. You must use the cells all of one size and of one kind.)—T. J. O'C. (Certainly, and in any textbook; also in our columns over and over again. 2. As to the telephone, several plans have been described; a battery at each end is best.)—J. S. Saddler. (You have nothing to do but to make them of the size you think suitable. A copper jar and a zinc split cylinder, plate, or preferably a rod.)—W. W. W. (Any textbook. Won't the present series of articles suit you.)—Produco. (In many works on mechanics, or briefly in such books as Molesworth's "Engineers' Pocket Book." The data are from actual trials.)—M. B. (*The Miller*," weekly, 69, Mark-lane, E.C.)—J. M. B. (Yes, we believe so; but do not know cost, if any. The workshops would have to be inspected. You should apply direct to the Home Office, Whitehall, S.W. Extra rates are charged; but not very high, and it is compulsory to state real nature of the goods.)—Engine. (Best thing is to fill up with fresh filtered water before starting on each trip. If the boilers lie unused for any length of time, fill them quite full and keep them so. A little salt scale will not do much harm. Common washing soda is the only chemical you need.)—School Boy. (To large firm certainly, with a mixed practice. Premium a matter of arrangement.—W. Seagrave, jun. (The English Mechanic is published here at two o'clock every Thursday, and it is the fault of your local bookseller, or his London agent, if he is not able to sell it to you on the following day.)—Novice. (It is not true.)—T. Lisle. (We do not pay for such contributions. Look earlier than the volume you mention, and we think you will find violin construction has had its share of space and attention.)—Shock. (1. Yes. 2. A matter of choice. 3. Yes; b you ought not to catch cold; in very cold weather t sponge bath instead.)

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

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Epps's Cocoa.—GRATEFUL AND COMFORTING.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctors' bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—Civil Service Gazette.—Made simply with boiling water or milk. Sold only in packets labelled—"JAMES EPPS and Co., Homœopathic Chemists, London."—Also makers of Epps's Chocolate Essence.

Holloway's Ointment and Pills are remedies [illegible] the treatment is easily applied, certain in its effects, and perfectly [illegible]. For all [illegible] complaints, this Ointment rubbed [illegible] over the [illegible] night and morning gives ease and [illegible] asthma, &c.

OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆

Wanted, **Euphonium**, in good order, exchange [illegible]

"**English Mechanic**," from September 1st, 18[illegible] [illegible]

Wanted, all kinds of useful **Apparatus**, in exchange [illegible]

Net Hammock, watchmaker's tools, materials, watch cases, [illegible] silver watch for camera [illegible] London.

Kent's Patent **Roller Skates**, [illegible] almost new, 10s. [illegible]

What offers in exchange for [illegible] numbers of "**Imperial** Journal [illegible]

Handkerchiefs – Two dozen very fine pure linen cambric [illegible] exchange anything [illegible] Belfast.

Lockstich **Sewing Machine**, quite new, value £5, in exchange for a 3-quarter-horse Boiler or Engine. Advertiser is willing to give a small amount in cash, and 3 years' numbers of ENGLISH MECHANIC.—Address, S., *Chronicle* Office, St. Neots.

Will give Silver Lever **Watch**, for magic lantern and a few slides, out of repair no objection if mendable.—TANNER, North Parade, Horsham.

Exchange pair of **Bell Telephones** and **Electro**-TYPING APPARATUS, complete, for 2½ or 3in. centre lathe or fretsaw machine, with lathe combined.—S. CARTER, 12, Park-street, Stafford.

Bell Fittings, good assortment, sent in by mistake; 50s. worth. Exchange fret machine or treadle grindstone.—11, Minster-street, Reading.

Nearly complete, "**English Mechanic**": what offers? Unbound; want good fret saw.—W. SAWDON, Bridge-street, Whitby.

Wanted, **Slide-Rest**, for 4in. centre lathe, in exchange for five moulds for casting, in plaster or composition, classic busts, 13in., 11in., 7in. high.—J. B., 12, Bessborough-street, Pimlico, S.W.

Engine Castings, one set, partly finished, cylinder 1in. by 2in., with turned flywheel; offers exchange.—S., 20, Blurton-road, Lower Clapton, London, E.

Two turned **Flywheels**, 5 inches, 6½oz. each; four turned Standards, 1¼oz. each; one grooved wheel, 3½in. been Saturday, Wednesday.—As above.

A **Model Force Pump**, in working order, will exchange for electric bell.—Particulars of S. LAMPARD, High-street, Merton.

Have various useful **Exchange** to offer, for a lathe-head, single gear, about 3in. centre; also short heavy lathe bed wanted.—ALFRED CROFTS, Dover.

For exchange, about 50 **Photo. Lantern Slides**, 3¼ size; will exchange for others.—Address, W. FINLAY, 135, Renfrew-street, Glasgow.

American **Orguinette**, with lot of music, cost £3; want emery grinders or vertical drilling machine.—CHILDS, Blandford.

Hancock's Patent **Potato Washer**, equal to new; exchange for small lathe or a good telescope.—CHILDS, Blandford.

Wanted, good **Fret-Cutting Machine**, with [illegible] lathe bed; exchange scientific books.—CHILDS, Blandford.

Pulvermacher **Chain Band** and **Battery**, complete, in case, and in good order; what offers in exchange?—J. FORBES, 6, East London-street, Edinburgh.

Magic Lantern with Slides, and box of conjuring tricks, nearly new. Will exchange anything useful.—A. SUGAR, Lockwood.

Half H.-P. Horizontal **Engine**, in exchange for a good set of Whitworth Taps, from ¼, 5-16, to ⅝ and cash.—C. L. GRAVES, 58, High Cross-street, Leicester.

Stock and Dies, for ¼, ⅜, and ½in. brass tube, scarcely used; for exchange.—GEO. WARD, Amersham, Bucks.

Wanted, 52in. **Bicycle**, at once, roller bearings preferred, in exchange for first-class Silver English Lever, cost 7 guineas, good as new.—T. MALONEY, Tadcaster, York.

Powerful **Medical Coil**, with regulator, two three-pint cells, in handsome case, switch, electro-magnet and lamp. Offers.—A. W. N., 28, Eyre-street, Chesterfield.

Quarter-plate Landscape **Lens**; Solomon's magnesium lamp, opera glass, Sciopticon, 20 dozen gelatine plates. What offers in exchange?—L. DIXON, Hale-street, Colne.

"**Chemistry, as Applied to the Arts**," eight volumes Mackenzie, and "Popular Educator," four volumes Chambers. What offers?—T. M. SMITH, Kirkbean, Dumfries.

Will exchange, **Microphone**, three self-lighting gas burners, photographic disc, Jamieson and Bridge's "Algebra," Ferguson's "Astronomy," Woodhouse's "Astronomy." Wanted, Globes, Field Glass, or offers.—CHAPMAN, Stocksbridge, Sheffield.

"**Tyndall's Electricity Notes**," "Angell's Physiology," "Buckmaster's Advanced Chemistry," "Gardiner's Acoustics," "Hunter's Book-keeping," questions. Exchange "Thorpe's Chemistry," or offers; cost 7s. 6d.—FARNDALE, Loftus, Cleveland.

Wanted, a **Rob-Roy**, or other good make of canoe, for cash and part exchange—lathes, engines, and boilers.—J. DAVIS, London-road, Derby.

Wanted, small **Launch Engine and Boiler**, for cash and part exchange—lathes, &c.—J. DAVIS, London-road, Derby.

¼-Horse **Engine** and **Boiler**, complete; exchange wanted in canoe, launch machinery, small lathe, &c.—J. DAVIS, London-road, Derby.

Splendid **Model Engine and Boiler**, ⅝ bore, brass tubular boiler, all fittings complete, highly finished; exchange.—J. DAVIS, London-road, Derby.

A first-class new **Lathe**, by Mills, Sunderland, 3in. centres, gap-bed, back-gear, slide-rest, 4-speed turned flywheel, iron standards, treadle, tool board; part exchange.—J. DAVIS, London-road, Derby.

Good Treadle **Lathe**, new, 3ft. bed, 4in. centres, flywheel, crank, treadle, pine framework, nicely painted; exchange in small engine or boiler.—J. DAVIS, London-road, Derby.

Six-inch **Slide-Rest**, quite new, too large for owner's lathe; good exchange.—A. TIDMAN, 116, High-street, Southampton.

Electrical Machine, large, powerful, size of cylinder 12in. by 9in., brass conductor, on mahogany stand, cost six guineas; what offers?—HALL, 285, Liverpool-road, London.

Wanted to exchange, **Mortising Machine**, door clamp and floor cramps, for small engine and boiler, to work a [illegible] pump.—V[illegible], Chalk-lane, Hull.

Quantity of **Chemicals** and Chemical Apparatus; will exchange for joiner's tools or anything useful; list sent.—A. M[illegible], Morton, near Bingley, Yorkshire.

What offers for Ramsbottom's Patent **Three**-[illegible] RAM ENGINE, 2¼in. bore, 5in. stroke, in good working order.—WILSON, 15, Gilsland-street, Sunderland.

Wanted, **Lathe** or **Lathe-Heads**, 4in. or 5in. centres, in exchange for valuable series, engravings of Hogarth's works, with letterpress descriptions.—OAKWOOD, Church Stretton.

One-horse power horizontal **Engine**, first class condition; wanted, small dynamo, &c., tools, or offers.—W. C. [illegible], Ramsay-street, Rochdale.

"**Cassell's Family Physician**," 1882, 33 parts, clean and perfect, unbound, cost 16s. What offers?—W. SAUNDERS, [illegible], Dickleborough, Norfolk.

52in. **Bicycle**, new this season, cost £8 10s., cranked handle bar, roller bearings, cones to back; exchange 3in. or 3½in. [illegible] chuck, or pair of 3in. good headstocks back geared, or small back geared lathe with slide-rest, or 3in. inverted [illegible] reverse motion.—T. B[illegible], 20, Lancaster-road, Preston.

Will exchange **Electric Railway**, 5ft. circular line, motor, three carriages to imitate the Egyptian ironclad train, and battery, all complete, quite new. Wanted astronomical rack work slides, no less than 3in. or 3in., or what offers.—HARRIS, 21, Crossburn-street, Glasgow.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Cork-cutting **Machine** on the most improved principle. All kinds of engineering for the cork trade. Old corks re-rounded and made equal to new.—Address, JOHN LOWMAN, 18, Albany-road, Camberwell, S.E.

Gas Engines, small power, used in all trades, simplest made.—Sole Manufacturer, W. HUTCHINSON, Liversedge, Yorkshire.

Cast Steel.—Practical process of welding, tempering tools, springs. Manual, 12 stamps.—J. F. BREMNER, Caparstane-row, Aberdeen.

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Magnificent collection of Foreign **Stamps**, 2,100, all different, value by "Gibbons" over £32. What offers? No cards.—C. A. P., 23, Duncan-terrace, Islington, N.

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Friction Pulleys dispense with fast and loose pulleys—one answers for both. Invaluable for ropes and belts. Illustrated circular free.—BAGSHAW and SONS, Batley.

Wheels, dog cart, van, omnibus, cab, all kind and sizes, new.—10, Pitlake Bridge, Croydon.

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Ventriloqual and Marrionette **Figures**, either in parts or complete figures. List one stamp.—E. LE MAIR, 8, Coupland-street, Manchester.

Glazier's **Diamond**, Sharett and Newth's, cash 13s. 6d., bargain, cut 32oz. glass.—A. TOWNSEND, High Town, Hereford.

Sike's **Hydrometer**, complete, with ten weights and ivory thermometer in mahogany box, trial glass, and book of instructions, 25s.—A. TOWNSEND, Hereford.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 7, 1883.

THE COST OF PRIMARY BATTERIES.

THE statements which have been recently made in the daily papers as to the effects produced by the use of primary batteries in lighting railway carriages have brought us many queries, not a few from persons who appear to imagine that the cost of lighting by that means is measured by the first cost of the battery and the lamps. Most schoolboys have nowadays learned the simple lesson that out of nothing, nothing comes; but judging by some of the paragraphs that we have seen in daily papers, it is perhaps excusable that not a few of our querists should imagine that something remarkably cheap has been discovered, and that they can have the electric light at a merely nominal cost. We have recently pointed out, not once merely, but several times, that an electric light obtained from any known battery is really expensive as compared with the same amount of illumination obtained from gas or other cheap source of light, and that there is no hope of reducing the expense until someone discovers a battery the decomposition of the elements of which will produce a substance or substances which shall be worth at least as much as the raw materials themselves. We have, from time to time, described cells or battery arrangements, patented and otherwise, the inventors of which thought they had made one step towards the desired goal; but at present, notwithstanding all the puffing, we are unacquainted with any battery which, all things considered, is cheaper than the well-known combination of zinc and carbon excited by dilute sulphuric acid and bichromate of potash or nitric acid. For bells, telephones, and telegraphs, electro-metallurgy and medical purposes, other arrangements are more suitable; but in the case of electric lighting and electro-motors, a constant and ample supply of energy to the full capacity of the battery is required, and at present we have not found a cheaper metal to oxidise or consume than zinc. This is an old tale. It must be quite forty years since Staite took out a patent in which the commercial value of the residual products was mentioned, and latterly we have had several inventors taking up the old idea, without, however, demonstrating by actual receipts that they obtained any return worth mentioning for the zinc and sulphuric acid expended. Probably if primary batteries came to be used on a very large scale indeed, a sufficient quantity of residual products might be obtained to find a ready sale; but it is extremely doubtful whether more than a fraction of the prime cost would be recouped, unless the battery can be induced to manufacture some unknown and really valuable substance whilst giving out current. In one of the new batteries, which is, we believe, working very well on several railways, lighting carriages with lamps of 5 to 10 candle-power, zinc and carbon form the two elements, and the battery is excited by a composition named "oxidone," the exact nature of which is kept secret until the patents are completed. The working cost of this battery is stated to be as low as one-eighth of a penny per hour for each 5-candle lamp, and a battery of 16 cells will supply 18 lamps, and can be charged for 40 hours—that is, the battery can be used for 10 hours on each of four days without needing to be recharged. Taking batteries as we know them in practice, such a result as that must be regarded as very good indeed; but if the cost has been arrived at by allowing for the sale of the residual products, it will at once be seen that the battery is not so cheap as a good steam-engine and dynamo, for when current is obtained by the oxidation of zinc the cost is about nine times greater than when a machine is used and the source of the energy is coal at about 20s. a ton. Mr. Sprague worked out this little sum for the benefit of all whom it concerns some years ago, and he found that taking the expense of the battery as only 4d. per pound of zinc the cost of a horse-power for 24 hours was 25s., whereas the same amount of energy could be obtained from a common steam-engine and coal at 20s. for 10·29d. Even if we suppose the residual products of any battery in which zinc is employed return 2d. for every pound consumed—and no one has supposed that possible amongst the most sanguine inventors—it will be seen that the common steam engine has still the advantage as a motive power. Electrical machines have been considerably improved since Joule calculated that 75lb. of zinc would be necessary for one to maintain a horse-power for twenty-four hours; but so have steam-engines, and therefore we are brought back to the simple datum that the oxidation of zinc can produce so much and no more energy, and that unless some one can be found to pay a high price for sulphate of zinc, there is no chance of any of the well-known cells in which it is consumed becoming a cheap source of electric light. It seems abundantly clear, from a number of experiments, that the most that can be expected from the best steam-engines and dynamos is 200 candles of incandescent lighting per horse-power; and as it is also tolerably apparent that two pounds of zinc are necessary to obtain the same quantity of energy, we have sixpence as compared with a farthing as the relative cost of the two sources of energy for electric lighting. It is not impossible that these figures are too favourable to the battery, for Mr. Sprague says that the cost of an equivolt of energy, by a common steam-engine, is only ·00112 of a penny, while by a Daniell's battery it is ·0541. There is this to be said, however, that even if the cost of working a 20-candle lamp is as much as one halfpenny per hour, there are many persons who would prefer it to gas or any other illuminant; and if the new batteries can be made to produce a really useful substance as a residual, the trouble and attention they may entail will not stand in the way of their adoption. So far as we know, a 20-candle light cannot be maintained at a cost of one halfpenny per hour, even when the zinc and the acid can be purchased in quantities at the lowest price; but if a battery is in existence which will yield such results, it is a pity those who own it do not make it known, for it is certain they would have a very wide sale provided they could guarantee its performance. At the price named it would be too costly for lighting on the large scale; but there are very many persons who would go to the expense of fitting up the battery and the lamp, if they could have a light of twenty candles at a cost of a halfpenny an hour. Possibly before long someone may invent an iron or a lead battery, and then those who are so anxious to have the electric light, will probably have an opportunity of gratifying their desires; as, indeed, they may now, if only they are prepared to pay for them. But so long as zinc is used there is small chance of primary batteries supplanting dynamos and steam-engines.

REVIEWS.

Flowers and their Pedigrees. By GRANT ALLEN. London: Longmans.

THIS work is a collection of the author's always readable and invariably interesting essays contributed to several magazines—this time on botanical subjects, and we have no doubt that those who read them in their more ephemeral dress, will be glad to have them in the handsome form in which the publishers have offered them to the reading world. The keynote of Mr. Allen's essays may be seen in the following sentences, in which he says: "We can now answer confidently: Such and such a plant is what it is in virtue of such and such ancestral conditions, and it has been altered thus and thus by these and those variations in habit or environment. Every plant or animal, therefore, becomes for us a puzzle to be explained, a problem to be solved, a hieroglyphic inscription to be carefully deciphered." Each English plant has not only a general history as a species, but it has also a separate history as a member of the flora of these islands; and the author accordingly explains first how it came to exist at all, and then why it exists in this country. The essays are eight in number, and commence with the pedigree of that lowly flower the daisy; then the author treats us to a short historical retrospect, and describes what he sees from Claverton Down, where he has found a wayside weed known as the hairy woodspurge, one of the few genuine links which unite us with a far distant past—a relic of the flora which once bloomed among the lowlands that connected England and Ireland with Europe. The hairy spurge is a Southern European and Western Asiatic plant, which nowhere comes any nearer to Britain than the Valley of the Loire. An easy explanation of its appearance on Claverton Down can be found in the supposition that the seed was brought from the Mediterranean, and, finding a suitable climate, the plants grew and flourished; but that explanation is much too easy for our author, who sees that the hairy spurge is one of the few relics of a flora which is being steadily driven out of Britain because the conditions are ceasing to be suitable for their existence. Thus in the "Romance of a Wayside Weed," Mr. Grant Allen contrives to talk about the Glacial period, and of the time when the British Isles formed the north-western coast of Europe; and that the reader may better grasp the lesson he wishes to teach, he provides him with a sketch-map of Post-Glacial Britain. The hairy woodspurge still lingers on Claverton Downs because that is one of the warmest spots in England, just as the Cheddar Pink grows in a single basking hollow heated by great walls of limestone upon the western flank of Mendip; just as the purple lobelia loiters in the warm valley of the Devonshire Axe, and the white sedum struggles on upon the edge of Malvern. The third essay is a comparison of the wild strawberry and the white potentilla, two sister plants of the hedgerows almost exactly alike except in that, to us, essential particular that the latter does not bear fruit. Cleavers form the subject of the fourth paper, in which the author hopes that his readers will think more tenderly and respectfully than formerly of an ancient and highly-developed English weed. In the fifth paper Mr. Grant Allen takes up the question of the origin of wheat, and startles the reader at the outset by the assertion that it is a degenerate and degraded lily—a text which enables the author to write one of his most interesting botanical essays. "A Mountain Tulip," a "Family History" (the roses), and the "Cuckoo-pint" conclude a volume which can be taken up at any odd moment, and will never fail to interest and instruct.

Energy in Nature. By W. LANT CARPENTER, B.A., B.Sc. London, Paris, and New York: Cassell and Co.

A COURSE of six "Gilchrist Lectures," on the forces of Nature and their mutual relations, was delivered by Mr. Lant Carpenter in the autum of 1881, and with some addi-

[illegible] they are here gathered into a book which has the recommendation of being printed in large clear type illustrated with many useful engravings. The subjects are treated in a popular manner, and as far as possible with an avoidance of technical terms which when necessary are carefully defined. Mr. Carpenter has made an attempt to lay down clearly the distinction between "force" and "energy." The latter he defines as power of doing work, and force may be defined as any cause which alters or tends to alter a body's natural state of rest, or of uniform motion in a straight line. The author proceeds to explain, but whether in a popular work that is altogether advisable may be doubted, for the majority of those for whom this book must be intended would have been contented with the simplest explanation, especially if accompanied by an illustration, and would probably have gained a better notion of the difference than from a whole page of definitions. It is more important in a work of the kind to take care that statements made are as nearly correct as possible, and the author will scarcely contend that the conductivity of copper for electricity is only 73 (silver being 100), or of gold only 59. In a work intended for popular reading it is doubtful whether it is wise to talk of the two electricities rushing together when wires from a copper and zinc couple are joined; but that, perhaps, is a small blemish in a book which forms an excellent present for an intelligent boy, and might be used with great advantage in schools as a reading lesson.

The Smithsonian Report, 1881. Washington: The Government Printing Office.

THE annual report of the board of directors of the Smithsonian Institution for 1881 is a portly volume of over 800 pages, about one-fourth of which are occupied by papers and reports relating to the business of the Institution, and the remainder by a record of recent scientific progress and a number of essays, chiefly relating to anthropological subjects. The system adopted by the board of directors in compiling their annual reports renders them of exceptional value to scientific libraries, and the gratuitous distribution of the volume to all societies in whose charge they are likely to be of value to students, is a feature to be commended as worthy of imitation by other institutions. The record of scientific progress is not so well done as it might be, for, in too many instances the records are simply bald statements that so-and-so has done this or that. The references are given, it is true, but as the periodicals mentioned often give no more information than is supplied by the Smithsonian "records," the student must still hunt up the originals if he wishes for fuller information. It would be better to select the really important items of progress and give more details, as Prof. Holden does in his report on astronomy. The miscellaneous papers on anthropology describe many interesting "finds" in the more settled parts of the United States, and serve to indicate what a rich field awaits the labours of the archæologist and the anthropologist of the future.

The Constellations and How to Find Them. By Wm. Peck. Edinburgh: Archibald and Peck.

This is a neatly printed and very clear guide to a knowledge of the starry heavens, [illegible] twelve maps showing the positions of the constellations in the sky during each month of the year, and in addition two [illegible] the stars near the North Pole which are always visible, and the [illegible] near the South Pole which [illegible] visible in Britain. An introduction [illegible] explanation render everything [illegible] to the novice, while separate editions of the maps will be found useful by the observer as he studies the stars from month to month. A list of the Arabic names corresponding to the Greek indicating letters, and tables of dates and hours at which the maps represent the appearance of the heavens, make the work as complete as can be desired by the amateur.

We have also received *Lantern Readings of Travels in the Eastern Island World, China, Loochoo, and Japan*, by F. W. SUTTON, R.N. (W. F. Stanley), consisting of short but pithy descriptions of a number of lantern photographs of scenes in the East. There are altogether eight readings descriptive of 421 lantern photographs taken by the author, including many subjects of interest to be observed during a voyage from Plymouth to China and amidst the Eastern Archipelago. Judging from the descriptive matter, these Lantern Exhibitions will be found a very attractive and interesting entertainment.——*Workshop Appliances*, by C. P. B. SHELLEY (Longmans), is the sixth edition of a well-known textbook, which has been revised and enlarged, and at the same time condensed to make room for new matter, chief of which is a supplementary chapter on steel. The book is freely illustrated with engravings, several of which represent very important modern workshop appliances.——*The Practical Boiler-maker, Iron Shipbuilder, and Mast-maker*, by R. KNIGHT (Wyman and Sons) is the third edition of a handbook which will be found useful by those to whom it is addressed. It is illustrated by 112 lithographed figures.——*The Artists' Table of Pigments*, by H. C. STANDAGE (Wells, Gardner, Darton, and Co.) is a useful work giving the composition, conditions of permanency, non-permanency, and adulterations, effects in combination, and reliable tests for purity of the known pigments. The size adopted may have been necessary for the tabular arrangement, but is very awkward.——*Designing Wrought and Cast Iron Structures*, by HENRY ADAMS, Professor of Engineering at the City of London College, (60, Queen Victoria-street, E.C.), is an endeavour to present the subject to the student in such a manner that he can grasp its principles, and at the same time the details which are usually known only to experienced practical draughtsmen. Part 1 contains notes, calculations, and working drawings for wrought and cast-iron girders of 20ft. span.——*The Patents, Designs, and Trades Marks Act*, 1883, by JAMES JOHNSON and J. HENRY JOHNSON (Longmans), is a reprint of the new Act, with notes on points of interest, by the authors.——*One Hundred Chess Problems*, by Rev. A. CYRIL PEARSON, M.A. (Civil Service Printing and Publishing Co.), is the third edition of a book of problems which has been already favourably received by all lovers of chess.

OBJECT-GLASS WORKING.—IX.

By "PRISMATIQUE."

OUR lenses are now ready for smoothing, and as this process is the same for all classes of work, and has been so frequently described in the pages of the ENGLISH MECHANIC, I will not here repeat the instructions, or the process of emery "elutriation," but refer the reader to letter 22,022, page 219, Vol. XXXVIII., and preceding volumes there referred to. The plan adopted by Mr. Wassell will commend itself at once. The purpose of smoothing is to produce a surface as fine in grain as possible, also as nearly spherical as possible; if any removal from the spheric shape is made, it must be done in the final polishing or figuring. It must not be supposed, however, that absolute spheric curves are got in the smoothing process: there is invariably a depressed zone, certainly of extreme minuteness as to depth, but still effective in spoiling the work of the o.g. if followed up. Fig. 11 is an exaggerated illustration of this condition. It will be seen that to bring about an approach to spheric curvature, either the centre and edge must be polished down, or the centre polished down and gradually worked out to the edge, or the edge polished off and gradually worked up to the centre. It will thus be seen that there is no arbitrary rule; still I am sure that the method of working off the centre is the least likely to produce rounding off or marginal error, and is the safest for the amateur of limited experience. We will suppose, then, that our lenses are smoothed as well as we can do them. We must look that the pitch is in perfect adhesion at the back: this will easily be seen, as the polished surfaces of the pitch will reflect more light where the air has got in. If there is any appearance of this "starting" as it is called, the lens must be warmed on by being placed in the tool it fits, if possible, and all warmed together, or on a thick iron plate. It is well to give it one or two wets of the finest emery before beginning to polish, if this proceeding has been found necessary. There are few methods of polishing that give so good results in a simple manner as dry polishing on paper: this method may be used in the present case, either with the polisher stationary, or on the vertical "mill" described in these papers. In the first method a strip of paper, the thinnest used for negative photo. printing, is laid across the centre of the tool, and the starch used pushed out at the edges, as described in my papers on "*Glass Specula Working.*" As the thickness of paper makes a great difference in the "take," it is not possible to give exact dimensions, two-thirds the diameter for the convex, and four-fifths for the concave surfaces, is generally about the mark. This can generally be decided by giving the lens four or five minutes' polishing with straight rubs, and at least two complete turns round its axis. The paper strips may extend to the edges of the tool to begin with, and, if the take comes on at the edge instead of the middle, the polisher may be shortened by cutting off ½in. at either end until a decided take in the centre is shown, or the stroke may be changed to a narrow ellipse, which will frequently answer the same purpose. By taking note of this, the operator will see the possibility of making use of these effects in the final figuring of the surfaces, for by altering the width, length, stroke, or size of the cork back sufficient variation may be obtained to produce elliptic curves, if such are seen to be needed. The material best fitted for polishing with is "Tripoli de Venise;" rouge may be used, but is troublesome unless the paper is first treated with "Tripoli." For polishing on the "mill" the method is slightly different; the paper used for this purpose should be Swedish filtering paper. This is a very thin paper much like blotting paper. The whole surface of the tool that has smoothed the glass is covered with this paper, which must be cut into three, four, or more pieces, so that it will fall into the curve without folds or ridges. There cannot be any pushing out of the starch with this; but the bruiser may be used with gentle pressure to remove air. If the tool is a little warmed, and the paper starched with a brush, it will be drawn down to the tool and will not need any pressure at all.

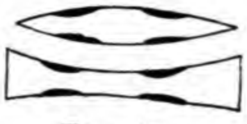

Fig. 11.

(*To be continued.*)

THE DYNAMO: HOW MADE AND HOW USED.—IX.*

By SELIMO R. BOTTONE.

§ 20. THE pattern for the *legs* of the electro-magnet (*field magnets, exciting magnets*) will next require our care. Since the two legs are exact counterparts, the one of the other, so we need only make one pattern, from which, however, *two* castings must be obtained. Fig. 15 illustrates the form and dimensions of this pattern on a scale of about one-quarter the real size. The dimensions are marked in inches.

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* All rights reserved.

A represents the outside view, *i.e.*, as seen from the side which is farthest from the armature; B gives the view from the inside (close to which the armature rotates).

To make this pattern, procure a piece of pine 6in. in length, 4in. in width, and ½in. thick, planed smooth, and free from knots and roughness. Glue and dowel along the bottom edge a strip 1⅛in. wide, 4in. long, and ¼in. thick, as shown at Fig. 16*a*. Now, with a sharp plane,

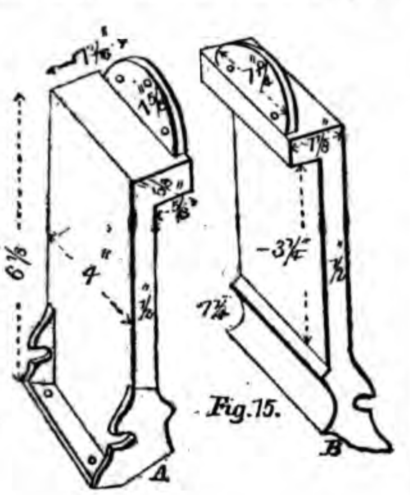


Fig. 15.

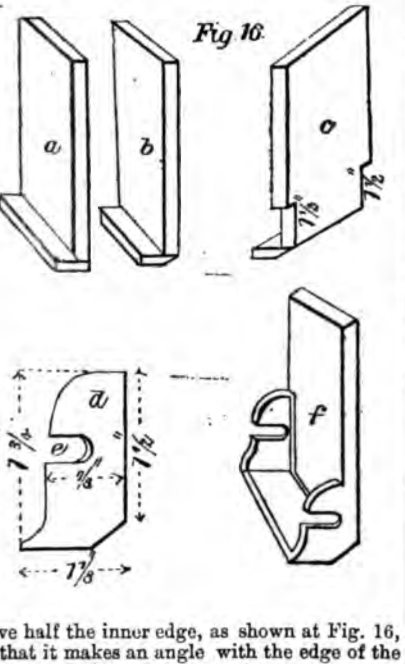
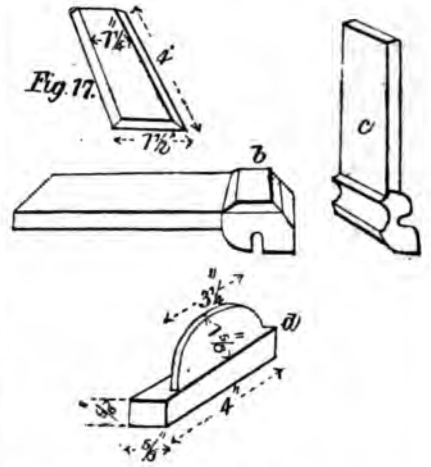


Fig. 16.

remove half the inner edge, as shown at Fig. 16, *b*, so that it makes an angle with the edge of the 6in. piece. With a fine saw cut a recess on each side of the jointed piece 1½in. long by 4in. deep, as shown at *c*, and glue and dowel in each recess the two flanges, made of ¼in stuff, of the shape and dimensions given at *d*. To insure the slot *e* being exactly at the same point in each flange, the two flanges, after being roughly shaped with a fretsaw, or otherwise, should be clamped together, and the finishing touches given with a rat-tail file, for the slot *e*, and with sandpaper along the rounded edges. Care must be taken that these flanges should be a trifle thinner near the edge marked 1¾ than on the opposite edge, to insure the pattern coming out clean from the mould. For this reason the slot *e* must not be narrower at the outside than at the inside, but rather the contrary. The slot *e* must be ¼in. wide, and must reach in depth to the 6in. piece, to which the flanges are attached. At this point our pattern will present somewhat the appearance shown at *f*. A piece of wood 4in. long by 1½in. wide, and ¼in. thick, perfectly smooth, square, and free from knots, must now be chosen, and the two sides planed away, on the upper side to such an extent as to make an angle of 60° with the base (see Fig. 17, *a*). With some good thin, hot glue (not Prout's), this piece is to be glued along the bottom edge of the 6in. piece, on the side opposite the flanges, and in such a manner that the slope of the base is continued by the *slope of the piece, as shown at* Fig. 17, *b*. When the glue is quite dry, by means of an inch gouge, cautiously hollow out along the entire length of this piece, in a semicircular form, nearly to the depth of the original 6in. piece, so as to fit accurately the pattern of the armature, which has already been made. (§ 19.) When this is as true and smooth as it can be made with the gouge, fold a piece of fine glasspaper over the pattern of the armature, rough side outwards, lay the armature in the channel, and work it backward and forward until perfect smoothness and a perfect fit are insured. The pattern should now present the appearance given at Fig. 17 *c*. When this end has been attained, four small dowels should be inserted



into the thicker portions of this semicircular piece, to hold it firmly down to the 6in. piece. We now need only make the top flange, by which the bracket or standard that bears the wheel is clamped to the legs of the dynamo. This is made most easily in two pieces, one being squared up to 4in. long, ⅝in. thick by ⅝in. wide. The other piece is to be ⅝in. thick, and must be cut into a perfect semicircle, with a radius of 1½in. By means of Prout's glue and a couple of dowels, this is neatly attached to one side of the other square piece, as illustrated at Fig. 17, *d*, and then the whole is carefully and squarely glued and dowelled, in like manner, to the top of the 6in. piece, so that it now presents the appearance shown at A and B., Fig. 15. The holes shown in the bottom and top flanges may be bored, and core prints inserted, *if the founder will take the trouble to put them in his mould;* but, as a rule, founders do not care to cast small castings with holes in them, as they seldom come true, so that it will be, perhaps, as well to have them bored afterwards, which can be done at a cost not exceeding 2d. a hole. This pattern must now be carefully smoothed, the sharp edges rounded, to insure parting from the mould, and finally paraffined and polished, as recommended for the armature, § 19, when it will be ready for the moulder.

PRACTICAL NOTES ON PLUMBING.—LXXXVI.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 260.)

Roof Work.

We will first commence our work by laying a few gutters, which will be a familiar kind of work to most of you, and I hope that you will all endeavour to work strictly to the rules and diagrams which I am about to lay before you, so that one and all may be able to answer any questions which I may have occasion to put to you from time to time. I particularly ask you to follow the instructions here laid down, because I have worked in almost every conceivable manner, and, after taking everything into consideration, I am now of opinion that the following rules properly carried into practice will be found the best and most suitable.

Measuring for Lead Gutters.

This is a point in your work which will require your particular attention, for although it is a simple matter to measure a single gutter, it must not be lost sight of that it must be done correctly, for what is worse than a short gutter? And yet it is a very common thing to find men in large London shops! holding the position of foremen of plumbers who are *continually* in the habit of cutting the gutters too short or too long, very seldom the latter. These men do this kind of thing continually, and will often get the men to stretch the lead from 2in. to 5in. or 6in. in ten feet; that is, in order to make the lead come in instead of sweating, burning, or soldering a piece on. I speak of this, knowing full well that it is practised, not only in the small shops, but in the large ones, which is a disgrace not only to the men, but to the foreman and his employers. Therefore, I ask you to be at all times very particular in all your measurements, and if you practise to do your work regularly it will save you a great deal of trouble, and be the means of your work coming out at a fair and reasonable cost, which should be of great importance to the foreman plumber. Suppose the gutter which you are about to lay to be one similar to that

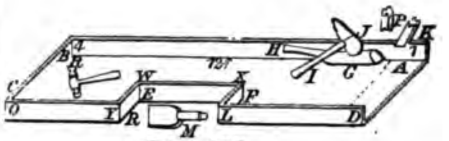


Fig 407.

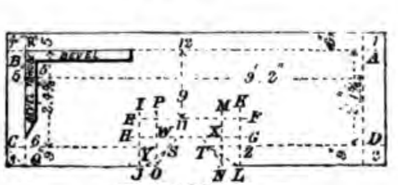


Fig. 408.

illustrated at diagram No. 407, which is an elevation, and let diagram No. 408 be a plan of the lead, and diagram No. 409 be the drip. Here

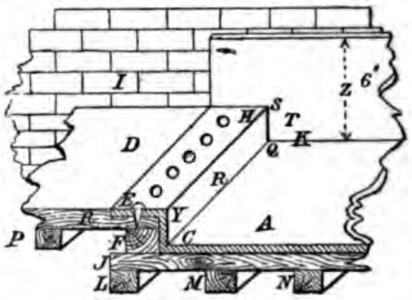


Fig. 409.

you have three views of what you will have to do. I shall now explain the method of taking the size and entering it in your pocket book.

First take the height of the turn-up against the wall. We will say that the specification states it to be "6in. all round brickwork (as at Z, Fig. 409) and 9in. under the slates," as at H E G, Fig. 409 A, and at springing, Fig. 411.

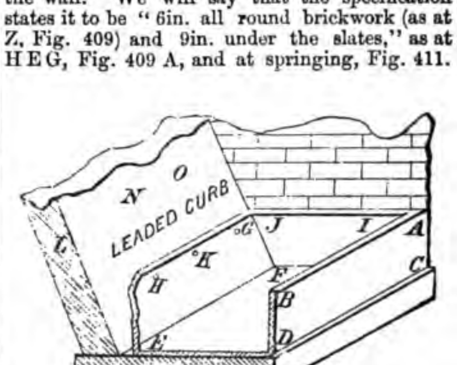


Fig. 409 A

But sometimes your lead may be only 5in. at the head, as at R, diagram No. 410; and if you have, say, 1½in. fall, then your lead may be 5in. at the head and 6in. at the drip. This will allow you to put in a straight length of flashing, and the gutter will be all the better. Therefore, we will say that the turn-up shall be 5in. at the head and 6in. at the drip. This being the case,

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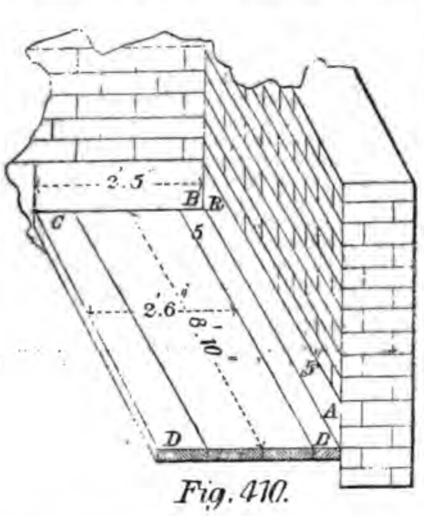

Fig. 410.

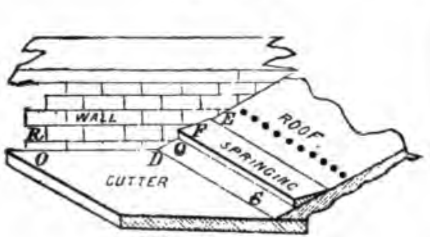

Fig. 411.

next measure the width of the gutter at the head; here say it is 2ft. 5in. Next measure it at the drip; here you will most likely find it to be considerably less, according to the pitch of the roof and the fall of the gutter; say that it is found to be only 2ft. 1½in.; next measure for the other turn-up, which may be to go up a slated roof with springing. If so, and the springing is nailed on, say, 4in. up the roof as at F (diagram 411), then the lead should be cut to come up the springing, and if the pitch of the roof be easy, as there shown, it should go well up the roof at least 5 or 6in. past the sharp arris F; but if the pitch of the roof be very sharp, as at F (diagram 412), then from 3in. to 4in. will answer. Now, having seen how far the lead should stand up against the walls and up the roof, proceed to examine the drip. Let us say that it is a 2in. drip, as at Y, Fig. 409, and that the splash lap G C (Fig. 113) is 2in. This will make up 4in. Now proceed to measure your gutter, and enter it in your book as follows. Say the measurements are in this case 5in. up the wall, 2ft. 5in. at the wide end, and 9in. up the slates, in all 3ft. 7in. The narrow end is 6in. up the wall 2ft. 2in. wide, and 9in. up the roof, which amounts to 3ft. 5in. This will suit your sheet, which is, say, 7ft. wide. Next take the dead length, which is, say, 9ft. 2in., say 5in. up the wall, or at the head, and with 4in. for the work*ing of the drip. Allow, say, 1in. more for trimming, &c., in all, 10ft.* *This will also suit your sheet, which is 30ft. by 7ft.* Now proceed to cut out your lead and mark each gutter, and as you measure them, beginning at the outlet gutter, number them 1, 2, 3, 4, &c., also the side of the building as east, south, north, &c. Having the lead cut out, next let it be hoisted and carried to its proper place, then proceed to lay it as follows. Again refer to diagram No. 408. Unroll the lead upon a clean place, let the lead be dressed out flattened, or smoothed over with a dresser. Now measure the side turn up, as at B4 and A1. Say that at B4 it is 5in., and at A1 6in. Now with a chalk line snap the line BA. Next measure the end or head BC, which should also be 5in. and with a level as shown at bevel (diagram 414), take the exact angle of the wall, as there shown, and place it upon the chalked line as shown at BEVEL diagram 408, and with your chalk line strike the line R Q parallel to the tongue of the level. Next take the width at the head of the gutter, which, as you remember, is 2ft. 5in. Do not measure 2ft. 5in. on your lead, for if so your lead would not go into its place, simply because the two turn up edges have a thickness, and which must be allowed for; say that it is 7lb. lead, then it would be nearly ⅛in. thick, and twice this equals ¼in., say ⅜in. more to allow the gutter freedom, this is ⅜in. less than 2ft. 5in.; therefore, measure the head 2ft. 4⅝in. Next measure the foot or bottom end—this was 2ft. 2in., therefore measure on your lead 2ft. 1⅝in. and strike the chalk line C D. Now measure the length to see if your lead is cut the proper size; say that it is, and let us assume that the gutter is a plain one, therefore, take no notice of the break lines at I P, F G, J L, &c. Now, according to the elevation in diagram 407, let the corners be worked or bossed up square. If so, cut the corners off as shown by the dotted lines at 3 and 4, diagram 408. Now that the gutter is lined out, the next thing is to "pull it up." This is simply done as follows: get a "pulling up stick," which is simply a piece of quartering, anything about 3in. by 4in., 4in. by 4in., or even, if nothing handier is at hand or cannot be procured, a scaffold board will answer; lay it on the line A B; now kneel upon this, say about 3ft. from the end, and your mate do likewise; you take the head and he the foot of the gutter (be particular that the "pulling-up stuff, or stick," is fair upon the line), and now with your hands, say 3ft. apart, take hold of the side, and *both together* pull up the turn-up as sharp as possible, and as shown at 1 and 4, diagram 407. This, if very stout lead, or if the lead is of a hard nature, or the weather very cold, may not turn quite so easily as you may wish, but if it does not come square up, push it back again and vigorously pull it up again, do it two or three times until it is middling sharp. Now serve the other side the same. This done, with a shorter piece of pulling-up stuff, pull up the end B C. Now the sides and end are turned up, get a dull-edged *hornbeam* dresser (some plumbers use a box dresser, but I prefer a good hornbeam for this purpose, as it does not strain the lead), and place it as shown at G H (diagram 407). Then let your mate, with a "holding down stick," K, hold the end of the gutter firmly down to keep it from springing up, and with a hammer, or better, with a mallet, as at J I, knock the dresser into the arris of the gutter, as shown at G (diagram 407), which will make the arrises squarer. Do not begin too near the end, but always keep away from the parts which are required to be *worked for the drip*, for if you should set this part in square, the chances will be that you will have to take the trouble of working the lead *very carefully* to prevent the making of holes, called "bird's eyes" or "cock's eyes," &c., for which you may be fined half a gallon for each offence, and for the second offence most likely told to go off the job.

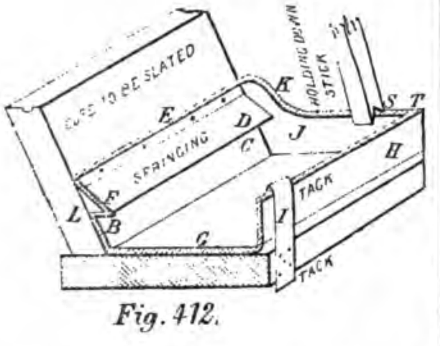

Fig. 412.

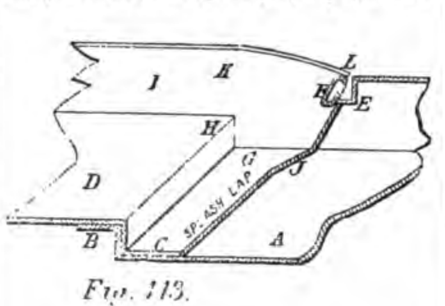

Fig. 413.

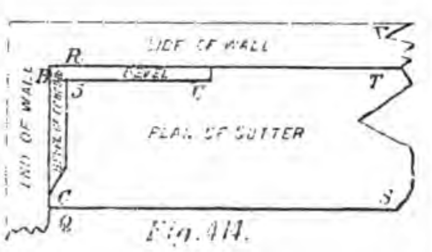

Fig. 414.

This setting in, as it is termed, must be done all round the sides and ends of the gutter, after which "square the sides." "Go round it" with the dresser. This is nothing more than beating (hereafter called dressing) the edges inwards, which thickens the lead in the arris and makes the lead come up quite true and square.

Having done this, next "break it up." This is done by putting your hands on the two stand-up edges, and about 3ft. from the end, and let your mate pull up the end at the same time you push the sides outward as shown at D T G (diagram 415). Some lazy plumbers do this with their feet.

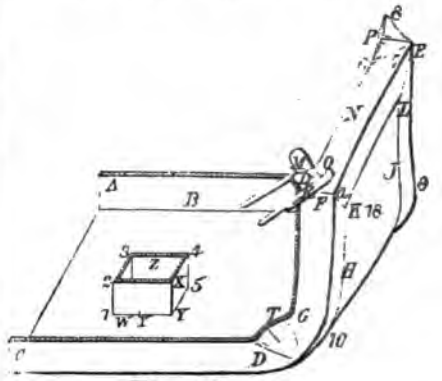

Fig. 415.

Now take the hornbeam dresser, and with its edge, and also with the mallet, make the stiffeners H K L J S, which is nothing more than the lead knocked back in a line, as illustrated.

(*To be continued.*)

SETTING AND CENTRING CORES.*

If there is any one thing that a machinist dislikes it is boring out holes that are not cored centrally. And why a moulder cannot always set cores centrally is something of a conundrum to him. Moulders can sometimes make excuses, and are generally ready to take a cast-iron oath that the core was set right, which the machinist, of course, cannot dispute. Still it will, I believe, be acknowledged by nearly all moulders that excuses for cores out of centre are about the worst kind of excuses we have to make. When you get a moulder so that he cannot say anything, it is a sin to torment him further; but it isn't often that you will get him there.

Why it is that *all* cores cannot be set centrally, is something that cannot be fully explained. To set a core centrally or straight does not call for any great mechanical skill. What is demanded is *care* and *thought*.

The accompanying engraving may assist in showing why some holes do *not* come central, and perhaps afford some help in setting cores.

The cause of holes being out of the centre is not always on account of the cores not having been set centrally. There are many things, such as uneven closing of flasks, bad fitting flasks, ill fitting cores, &c., any of which may result in crooked holes. Some readers of the *American Machinist* will remember about three years back some discussion upon core prints. To my mind the elaborate systems that some writers advocated had but little to do with what prints are practically used for. Prints are for no other purpose than giving bearings, and holding cores.

And whether bottom core prints are tapering, as seen in *Third core*, or straight as shown in all the others, has but little to do with the holes being out of the centre, which I think is a vital part of the question. The top prints are the essential ones, and even they often have but very little to do with poor holes. As a general thing long top taper prints afford a better chance for the cores to accommodate themselves to their centre. For long cores where there is uncertainty about measuring, such prints as are shown with *First core* are reasonably certain of

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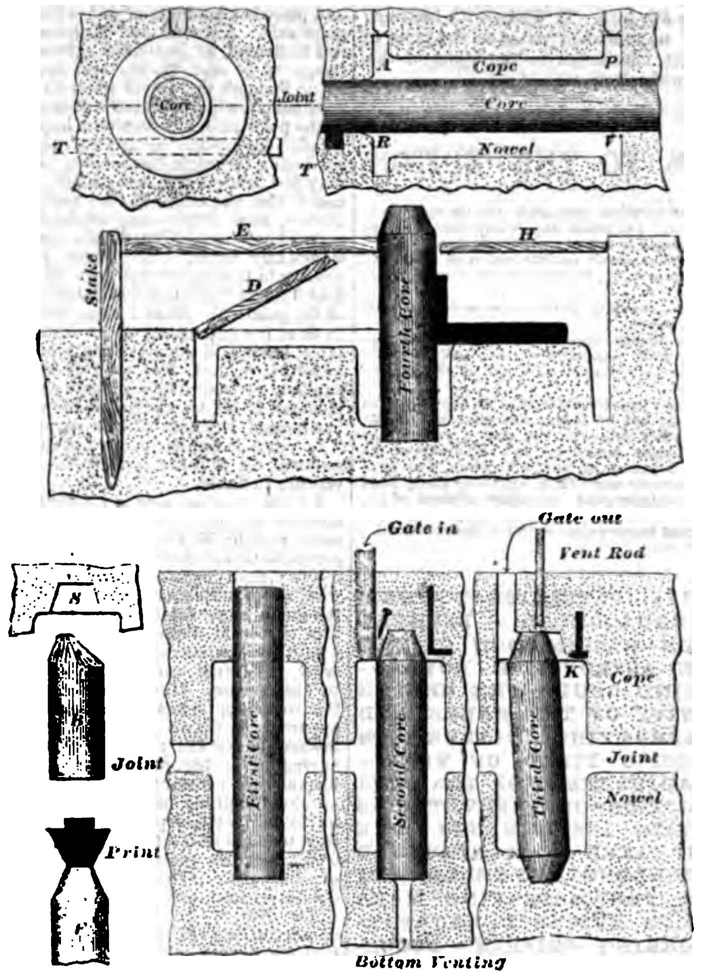
* By Thos. D. West, in the American Machinist.



providing for a true hold. This form of a print is the most reliable one that can be used, as with it the moulder can see whether the core is in its right place or not. In fact, by the use of such a print, it would be a hard matter to get the core out of its centre. Some may think such prints should always be used; but they are objectionable, from the extra labour and time which their use involves. It may be said that there is no gain, if through the quicker plan the casting is lost; but all castings are not lost. It is only the ones that are wanted in a hurry that we lose.

The cause of many crooked holes where the popular common top-tapering print is used, is as illustrated at *Third core*. As a general thing nearly all pulleys, gear wheels, &c., have either feeders or pouring gates on the hub. These holes break away or weaken a portion of what should be a firm, true, sound, tapering point, and the core leans to the weak side, with the result shown.

There are a few moulders who always close such moulds as the above, with the gates in place, as shown at *Second core*. By this plan it is evident that much of the risk is lessened.

The gaggering and nailing around the *Second core* is another safegard against the core crowding the print to one side. Another point that will bear looking at is that of the taper ends of cores.

A large number of foundries make all their common sizes of round cores, without having the taper end formed. Then, again, a large number of shops make their cores, having the taper end on them.

Filing a taper on cores is often very objectionable, especially when done by a careless moulder. A fair illustration of careless work of this kind is shown on core B. If a central hole is got with such a core it can't be charged to good management.

A careful moulder will compare his print and core together, as seen at F, thereby making a core that is likely to fit and fill the female print S.

Cores with taper prints are often one-sided, from being laid down upon plates to dry, although some, by nailing the heads, or packing sand under to hold them up, will get a very fair tapered head.

In some shops, in order to get good round straight cores, they are dried in half-round iron boxes of the same diameter as the cores. This is the only reliable way of making true taper end round straight cores. The plan is an old one, and the cause of its uppopularity is the expense of making the cast-iron boxes.

At E, D, H, and at the square, are shown the methods generally employed in setting and centring cores. With the exception of E, the plans are popular, and call for no comment. E is a plan whereby cores in such *moulds as green-sand* propeller wheels, and others having no points to measure from satisfactorily, can be centred. The plan is simply the driving of three or four stakes outside or away from the mould, before the pattern is drawn, the stick E being placed against the pattern print, and all the stakes driven the length of the stick away from the print. The core, when set by the same stick, will of course occupy the same position in the mould as the print, and therefore as far as centring is concerned must be right. The plan is applicable in other ways than shown; and while the idea may be old to some, it will be new to many.

The carrying off of such core vents through the cope is often the cause of weakening top prints, and also the cause of blow ups, from metal getting into the vent. To avoid this danger, it is the better plan to carry off the vent through the bottom board, or by running a long vent down into the moulding floor, as in the case of bedded-in moulds.

Some will say, that is all right, providing you have a cinder bed under the mould. I have carried off the vent of cores as large as 1ft. in diameter, and more in length, by simply driving a ⅝in. vent rod down 2ft. or 3ft. in the sand below the mould. Green sand, where you have a large body, is capable of carrying off and holding more gas than is generally thought; and to such as never tried this plan I would say, Do so; for I know they will find it a safe and reliable way of carrying off vertically set core vents.

In the upper part of the cut are represented ideas that to the novice may be of some value. It represents the finning or chamfering of core prints, in order to prevent the crushing of flanges, &c.

There is much that might be said upon the question of horizontal core setting. But I will at present confine myself to saying a few words upon flange crushing, a thing very likely to occur. The greatest cause of flange crushing is probably due to the irregularity and over-size of cores. Should any of my moulders lose a casting through the above cause, I would hold them responsible, although I might reprimand the core-maker for making the core too large. In our shop it is the custom for all pipes or moulds having flanges upon them to be tried off and on. This gives the moulder a chance to see if there is any liability of his mould or flanges being crushed; and if there is, he has time to go for the core-maker, in which he will have my assistance. The practice of thus trying off and on all such moulds, has been the means of saving many a casting from going to the scrap pile. I think it is a safe assertion to make, that in not one of fifty shops (and I feel like doubling the number) is this the rule. I know that it takes more time; but will say that in our shop I have yet to see a casting lost through having a crushed flange—a thing that but few foundrymen can say.

Having all castings good, far more than balances, in dollars and cents, the little extra time taken up in trying off and on all such copes.

NEW METHOD OF BRONZING IRON.

ACCORDING to L. Meyer, in the *Polytechnisches Journal*, the following method is successful in producing a bronze-like surface which practically prevents rust. All the methods as yet known for producing a bronze-like surface, by rubbing over the surface of the iron an acid solution of copper or an iron solution, letting it dry in the air, brushing off the rust produced in this way, and an abundant repetition of this method, give a more or less light or dark reddish-brown crust of rust on the iron body. Objects formed of iron can easily be covered with copper or brass by dipping them in the requisite solution, or by submitting them to the galvanic method. The surface, so prepared, however, peels off in a short time, especially if the surface of the iron be not polished at the time: by exposure to moist air in particular. By the method given below, it is possible to cover iron objects, especially such as have an artistic aim, with a fine bronze-like surface; it resists pretty satisfactorily the influence of moisture, and one is, moreover, enabled to apply it to any object with great ease. The clean, polished objects, are to be exposed to the action of the vapours of a heated mixture of hydrochloric acid and nitric acid, in equal portions, for from two to five minutes; they are not to be shifted, and the temperature may range from 300° to 350° C. The heating is continued so long that the bronze-like surface is well developed on the surface of the objects. After the objects have cooled, they should be well rubbed down with vaseline and again heated till the vaseline begins to decompose. When again cold they should be a second time treated with vaseline in the same way. If the vapour of a mixture of the two concentrated acids is allowed to act on an iron object in this manner, a light reddish-brown tone is developed. If some acetic acid be mixed with the two acids, and the vapour of all the acids together be allowed to act on the metallic surface, a surface of a fine bronze yellow colour can be obtained. By using different mixtures of these acids, every tint, from a dull red-brown to a light brown, and from a dull brownish-yellow to light brown-yellow can be produced on the surface of the iron. In this way some T-rods for iron boxes were covered with a bronze-like surface, and at the end of ten months, although exposed during the whole time to the action of the acid fumes of a laboratory, they had undergone no trace of any change.

Digestibility of Raw and Cooked Meats and Milk.—E. Jessen has recently completed some interesting investigations regarding the time required to digest meat and milk prepared in different ways. His first experiments were made with artificial gastric juice. Twenty-five grammes of beef were placed in it for 24 hours, and the undissolved portion weighed at the end of that time. Of the raw beef about 5¼ grammes only remained, of the half cooked 9¼ to 9¾ grammes, while that which was well done left from 17 to 18 grammes. The next experiments were made on a dog with an opening in the stomach. Here too the raw meat digested more quickly than boiled or roasted meat. The time for raw beef was 5·3 to 5·5 hours. Experiments were also made upon men by introducing 100 grammes of meat and 300 cc. of water into an empty stomach. After a certain time the contents of the stomach were pumped out, and if the microscope detected no muscle fibres, the digestion was considered finished. The time required was as follows:—Raw beef, shaved fine, 2 hours; half done boiled beef, shaved fine, 2½ hours; well done boiled beef, shaved fine, 3 hours; half done roasted, shaved fine, 3 hours; well done roasted, shaved fine, 4 hours; raw mutton, 2 hours; raw veal, 2½ hours; raw pork, 3 hours. In the experiments with milk such a quantity was given as to correspond in the quantity of nitrogen it contained to 100 grammes of beef. The time was as follows: 602cc. raw cow's milk, 3½ hours; 602cc. boiled cow's milk, 4 hours; 602cc. sour cow's milk, 3 hours; 675cc. skimmed cow's milk, 3½ hours; 655 cc. raw goat's milk, 3½ hours.—*Zeitschrift für Biologie*.

New Catalogue.—Messrs. H. and E. J. Dale, of 25, Ludgate-hill, have issued a new catalogue of Electrical and Physical Apparatus, which will be useful to many of our readers. Messrs. Dale supply all the modern forms of static electrical machines, including the Wimshurst and the Molison: all sorts of bells and batteries, and the various parts for making them. Their catalogue is something more than a mere price list, as it supplies a great deal of useful information, and answers many of the questions which we receive regularly every week.

SCIENTIFIC NEWS.

THE death is announced of Prof. Sven Nilson, the well-known Swedish naturalist, at the ripe age of 97. He was born at Landskrona, in March, 1787, and so long ago as 1811 obtained the degree of Ph.D. from the University of Lund. His magnum opus is the work on the Scandinavian fauna, which occupied him for more than 35 years.

Mr. J. E. Howard, F.R.S., chemist and quinologist, died the other day at the age of 76.

The death is also announced of Prof. Ercolani, of Bologna.

At Leeds, the other day, Mr. Arthur Nicols delivered a lecture on "Snakes and Snake Charming," in which he referred to the highly-poisonous character of the true sea-serpent, and gave an instance of the appearance of the mythical monster which occurred in his own experience. That turned out to be the body of a dead whale around which were collected thousands of gulls and albatrosses, and which simulated the shape and form of a monster with a mane and long tail. It is a pity that every master of a vessel from which the sea serpent is seen has not courage enough to steer close to it, so that its real nature may be made evident.

At a recent meeting of the Manchester Association of Foremen Engineers and Draughtsmen, Mr. J. Nasmith read a paper on the recovery of by-products in the manufacture of coke. After describing the Simon-Carvé and the Jameson processes, he mentioned some applications of the principle in the utilisation of the waste heaps which often become a nuisance in the colliery districts. In two experiments the heap was covered with sand and the gas was withdrawn by means of a blower through pipes sunk to a depth of six feet in the heap, resulting in the recovery of a considerable quantity of ammoniacal liquor with some tar oil. A Mr. H. L. Annom has taken out a patent for dealing with similar waste in future. Culverts are laid in the ground and the heap piled over them: when sufficiently large, it is fired and the gas withdrawn through the pipes.

Dr. Forster, of the Laboratory for Hygiene, Amsterdam, is of opinion that boracic acid is not to be recommended for preserving articles of food, and more especially should not be added to milk intended for young children.

M. [illegible] of Stockholm, has sent to the Academy of Sciences a note relating to copper and cholera, in which he says that in 1853 small bars of copper were worn over the pit of the stomach with wonderful advantage. Cholera has raged several times at Stockholm, but has never extended so far as Falun, where the copper mines are situated. He, however, evidently thinks that it is not the [illegible] vapours, which sometimes are discharged in considerable quantities, that give to Falun its immunity from cholera.

Dr. Friedlander has added to the history of the germ theory by exhibiting before the medical societies of Berlin specimens of the micrococcus of pneumonia. Injections or inhalation of the pulverised masses invariably produced true croupous pneumonia in mice.

Leech farming is successfully carried on in [illegible], and the industry has been recently started in Florida.

The water having been recently drawn off from the carp pond near the White House, Washington, which is one of those under the control of the Fish Commission, the increase in one year was found to be [illegible]. The fish varied in size from the young of half an inch long to respectable carp of two and three pounds weight. The pond has an area of about five acres, and is of very small depth.

The collection illustrating the fauna of the Bay of Naples, which was shown at the Fisheries Exhibition, has been secured from Dr. Dohrn for the Cambridge Museum of Comparative Anatomy.

Mr. W. O. Crosby has been studying the coral reefs of Cuba, and has arrived at the conclusion that they indicate a slow subsidence of that island during their formation, and that Darwin's hypothesis is consequently the true one.

What is called a "posthumous" essay of the late Mr. Darwin's was read at the Linnean Society on the 6th inst. It deals with instinct, and is full of unpublished notes on the facts of animal instinct, considered in the light of the theory of natural selection.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *31, Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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JUPITER'S IVth SATELLITE—THE NEW PARIS EQUATOREAL — DIURNAL NUTATION—RESIGNATION OF THE BELGIAN ASTRONOMER-ROYAL — AN UNKIND "CUT"—THE CENTRE OF GRAVITY OF THE EARTH AND MOON—SURVEYING INSTRUMENTS —TELESCOPIC FIELD OF VIEW — FOCAL ADJUSTMENT OF TRANSITS —DESCRIPTIONS OF OBSERVATORIES AND THEIR INSTRUMENTS — THE NEAREST FIXED STAR—APERTURE AND FOCAL LENGTH OF TELESCOPES —POWER FOR OBSERVING MARS —MENISCUS EYEPIECE—EQUATOREAL WORKING STIFFLY — FOCUSSING EYEPIECES — WELLS' ALTIMETER, AND MEASURING MOUNTAIN HEIGHTS — ARGELANDER'S STAR CHARTS.

[22097.]—LOOKING through the last Volume (XXXVII.) of the ENGLISH MECHANIC, I have just come across a report of the April meeting of the Royal Astronomical Society, on p. 147, whence it would appear that Captain Noble read a paper on an extraordinary discrepancy between the time at which Jupiter's IVth satellite really disappeared on April 4th, and that at which its eclipse was predicted in the *Nautical Almanac*. According to your report, the author of this paper seems to have held the satellite in view for 24 minutes and 6 seconds after it ought (theoretically) to have disappeared. Reading on, I find that Mr. Marth attempted in some way to justify this discrepancy; albeit, it is not easy to make out whether his contention was that it ought to have occurred, even were the tables perfect or not. Turning now, though, to p. 237 of your current volume, I find Dr. Wentworth Erck inviting attention to identically the same error of 24 minutes in the *Nautical Almanac* in connection with the egress of this same satellite, after transiting Jupiter's face. This coincidence is at least worth noting; pointing, as it would seem to do, to a constant and well-defined error in the tables of Satellite IV. It is idle to blame Dr. Hind for this. Even a man of his ability cannot make bricks without straw. The money absolutely thrown away and wasted in one single year on the trumpery little "Committee on Solar Physics" at Brompton would very much more than suffice to furnish the material for removing a standing opprobrium to our National Ephemeris. Should, as I earnestly hope, Lord Crawford ever become a member of a future administration, astronomers will look to him to urge upon his colleagues the transfer of Imperial funds from a mere scientific imposture to the practical object of supplying a means of easily, and very approximately, finding the longitude.

The number of the Paris weekly scientific periodical, *La Nature*, for September 22, contains an engraving and article descriptive of an altogether remarkable equatoreal which, thanks to the munificence of M. Bischoffsheim, has just been installed in the Observatory in Paris. It would seem to be the invention of M. Loewy, the subdirector of that establishment, and consists, in effect, of an enormous instrument, bent at right angles towards the bottom of the Polar axis, such axis itself forming the eye end of the telescope; as the part bent at right angles to it and moving in the plane of the Celestial equator may be regarded as the object end. This second tube issues from a cube containing a small mirror bedded in flannel, and placed at an angle of 45° with both it and the polar axis. A second and larger mirror, also bedded in flannel, at its distal extremity reflects the image of a star to the one in the cube, and so up through the object glass to the eyepiece or micrometer, which is placed at the northern extremity of the polar axis. It would be impossible to give a detailed description of this instrument without reproducing the original engraving; hence, to all who may feel interested in the matter, I would recommend the purchase of the number (538) of *La Nature*, now before me, containing it. It only costs 50 centimes. The details are, some of them, sufficiently novel. The main principle of the novelty in this equatoreal is as old as the "Englefield Transit" of our fathers' days. The upper end of the polar axis enters a room, and the observer is to sit at the micrometer as he would at his writing table, having all the movements of the instrument under his control, by means of rods, screws, and handles, conveniently arranged at hand. Mr. F. Hément, in his description of the equatoreal which has formed the text of this paragraph, says that "La perte de lumière par le fait des réflexions successives est à peine sensible"—which I humbly venture to doubt.

I have, so far, seen no notice in any English scientific journal of what seems to me a noteworthy essay, read by M. Folie at the meeting of the Astronomische Gesellschaft, held in Vienna from the 14th to the 17th of September last. It was on the somewhat novel subject of *diurnal* nutation, and also on the much more familiar one of annual nutation. The idea of M. Folie is that if the earth consists of a fluid nucleus, surrounded by a relatively thin solid crust, a diurnal nutation must exist appreciable by observation. Having worked out the theory of this nutation, he has found that it should be most apparent in Right Ascension for stars situated towards 0h. or 12h.; and in Declination for those having 6h. or 18h. of R.A. Calculating from his formulæ the constant of diurnal nutation, as well as the longitude of what he calls "the first meridian" (or that passing through the axis of the least moment of inertia), he gives the constant as 0·05", and his prime meridian he fixes 20° west of Pulkowa. The stars he has used for this determination are those employed by the Elder Struve in determining the constant of aberration. M. Folie seems to have no doubt that his figures establish the existence of an observable amount of diurnal nutation. He expresses the opinion that the fluidity of the earth under a relatively thin solid envelope would thus register itself in the sky in a manner much more certain than has ever been believed to be possible by geologists and mathematicians. The geologists (M. Folie asserts) believe in the solidity of the entire globe; the mathematicians in that only of its crust. He does not conceive that such crust can exceed 186 miles in thickness.

Apropos of the author of the essay of which I have been speaking, I hear him spoken of as a possible successor to M. Houzeau, whose resignation of the post of Director of the Royal Observatory at Brussels has recently been such a deplorable loss to Belgian official astronomy. The reasons for this resignation seem to be very imperfectly understood even in Brussels itself. Of the regrettable result of it there can be no difference of opinion. M. Houzeau is best known in England by his most valuable "Répertoire des Constantes Astronomiques"; and by his really astonishing work (brought out in conjunction with M. Lancaster) the "Bibliographie générale de l'Astronomie," which you reviewed on p. 252 of your XXXVth Volume.

I do wish that your engraver had listened to my appeal to "reproduce accurately what I drew most carefully at the telescope," in cutting the wood block of Saturn for my letter (22053) on p. 261. Imprimis, I am at a loss to know why he has eliminated the black surrounding sky of my original drawing; and, in the next place, I drew the inner edge of the crape-ring in the ansæ perfectly sharp, while the engraving in my copy of the ENGLISH MECHANIC makes it *fade off* into the black sky. Mine seems a very indifferent impression, by the bye. I hope that the majority of my brother readers have got better ones.

I may tell "P." (query 52267, p. 272) that I deduced the centre of gravity of the earth and moon from the best and latest determination of their respective masses. As I told my querist in letter 22012 (p. 217), the centre of gravity of the earth and moon is 2898·54 miles from the earth's centre; and, of course, she must revolve round this point once a month. Hence, every fourteen days she is alternately 2898·54 miles before and behind her mean place, with the effect of causing a corresponding seeming oscillation in the sun's apparent motion; and this is called in astronomical books the lunar equation. Within the limits of accurate observation of such a body as the sun, this agrees with the result determined by theory.

"E. M. R." (query 52283, p. 273) should get a book which I have before recommended in these columns, Heather on "Mathematical Instruments" (Nos. 168, 169, and 170 in "Weale's Series"), published by Crosby Lockwood and Co. He will cognise parts of "Simms"—both engravings and letterpress—in parts of it; but accompanied by a mass of the most recent information with reference to mathematical, optical, surveying, and astronomical instruments.

With regard to the succeeding query by "E. M. R." (52284, p. 273), What does primarily determine the angular subtense of an eyepiece is the diameter of the diaphragm between its eye-lens and field-lens and the focal length of the object-glass. Hence, your correspondent will see that his concluding question is, in its existing form, unanswerable. He may find the angular diameter of any given eyepiece from Delambre's formula. Calling A such angle in seconds of arc, F the focal length of the object-glass, and *d* the diameter of the diaphragm, then $A = \frac{d}{F . \sin. 1''}$.

Let us take his own telescope, and suppose (as is most likely) that the diaphragm in the eye-pipe is ½in. in diameter. Then the formula becomes

$$\frac{0·5}{14 \times ·000004848} = \frac{0·5}{·000067872} = 7766·8'' = 2°2'46·8''$$

Hence, he would have a field of view of rather more than 2° in diameter. Were he to employ the same eyepiece with a telescope of 60in. in focal length, he would find that the diameter of the field would be reduced to something like 28′ 39″. But the only real way of accurately determining the angular diameter of the field of view of a telescope with any given eyepiece, is that which I have myself given in these columns, I think, at least, four or five times. It is to observe, by the aid of a sidereal clock, the exact number of seconds and fractions of a second occupied by a star as near the equator as may be, in transiting the field diametrically, and then multiplying this time in seconds by 15, and again by the cosine of the star's declination. Thus, suppose that *α* Aquarii was found to take exactly 1m. 33s. in crossing the field of an eyepiece centrally. Then we say

93sec.	log.	1·968483
15	log.	1·176091
0° 53′ cos.	log.	9·999948
1394·84		3·144522

So that the angular diameter of the field of our eyepiece would be 1394·84″ or 23′ 14·84.″

I may answer query 52285 (p. 273) by saying that astronomical transit instruments have the system of wires rigidly fixed in the focus of the object glass; capstan-headed screws, as a rule, clamping the inner and outer tubes firmly together. Then any focussing is done by pushing in or pulling out the eyepiece in its tube; inasmuch, as ex necessitate, when the wires are in focus, a star must be too.

I know of no work exactly answering the description given in query 52286 (p. 273)). An early volume of "Weale's Series," reprinted from Bohn's "Pictorial Handbook of London," contains an excellent popular illustrated description of Greenwich and other observatories; but it does not now appear in Crosby Lockwood's catalogue. It only cost a shilling. Engravings and descriptions of the Greenwich instruments, too, appear in some of your own early volumes; and there are splendid engravings, accompanied by elaborate descriptions, of the Washington instruments, in Vol. II. of Chauvenet's "Spherical and Practical Astronomy." This, however, is scarcely a "cheap" book, save in the sense that it gives abundant value for its price.

Possibly "E. M. R." will find what he wants in "L'Astronomie pratique en les Observatoires en Europe et en Amérique," of which Part I. is devoted to England, and Part II. to Scotland, Ireland, and the British Colonies. It costs 4s. 6d. a part, and (I think) Nutt, the foreign publisher in London, sells it.

If "Stellarius" (query 52296, p. 273) will promise not to tell anyone, I will, in confidence, inform him that the answer which he quotes from the *Girls' Own Paper* is hopeless rubbish. *α* Centauri is the nearest of all the fixed stars, but as its parallax is only 0·93″ it must be 221,000 radii of the earth's orbit from us, or, in round numbers, 20,411,400,000,000 miles!—a distance which light (travelling 186,000 miles a second) takes *nearly three years and a half* to cross. I should strongly advise the editor of the *Girls' Own Paper* to give a week's notice to the gentleman who "does" the astronomy in his valuable journal.

Mr. Nelson supplies a by no means unnecessary caution in the concluding sentence of letter 22070 (p. 279). Perhaps I may supplement it by advising all purchasers of telescopes to procure them of as long focus in proportion to their effective aperture as they can. It is a golden rule for obtaining the very finest definition, to get all the magnifying possible performed by the object glass; leaving as little as may be to be effected by the eyepiece. A long-focussed telescope is not, of course, quite so portable or handy as a "dumpy" of similar aperture: but this is an inconvenience to which anyone who intends to do real work will cheerfully submit.

I cannot say that my experience in connection with the observation of Mars is coincident with that of Mr. Holmes (letter 22075, p. 280). *Cæteris paribus*, Mars bears, with me, more magnifying than Jupiter; but, of course, at present he is very unfavourably placed for observation with the telescope, being much too near the eastern horizon during the available hours of the night. During the oppositions of 1877, 1879, and 1881, I had glorious views of the planet (of which I made numerous drawings) with a power of 250 on a 4½in. achromatic. It is but rarely indeed that Jupiter will bear such an amount of amplification as this.

I am entirely ignorant of the "Meniscus Eyepiece" (spoken of by "Makeshift" in reply 52319, p. 290) under that name; in fact, if it be true that it consists of "three meniscus lenses," I now hear of it for the first time in my life. Of course, the meniscus has been introduced into the astronomical eyepiece, with good results, as in the case of Sir George Airy's modification of the Huyghenian form (R.A.S. *Monthly Notices*, Vol. XXIII. p. 70); the Steinheil solid eyepiece (English Mechanic, Vol. XXXV. p. 570), &c.; but I must repeat that I have never in my life heard of such a construction as that which "Makeshift" describes, either for use with the telescope or the microscope.

"M. A." (query 52330, p. 291) says nothing of the construction of his equatoreal. Assuming it to be of the ordinary German form, there is nothing for him to do but to dismount the instrument, clean carefully all pivots and bearing parts with a soft duster and some sweet oil (which must be afterwards wiped off with a clean rag) and, on putting the mounting together again, touch all moving parts with a little of the finest watch oil.

The query of "R. S." (52337, p. 291) is a very puzzling one indeed, if, as I assume, his eyepieces are all mounted alike; because, *a priori*, the higher the power the further the eyetube has to be moved *inwards* to obtain the true focus. Unless I could actually see the telescope, or in the absence of more definite description, it would be impossible to answer your correspondent's question.

Assuming that "Penmaenmawr" (query 52380, p. 292) is familiar with the 4th Proposition of the VIth Book of Euclid, does he not see that he has only to call the 2, 4, 6, 8, &c., on the perpendicular of the triangle in the diagram on p. 218, 200, 400, 600, 800, and so on, to convert the corresponding figures on the base to similar quantities. Thus, to modify "Glatton's" example: If your correspondent were 1600ft. from the base of a mountain, and the plumb-line intersected the face of the altimeter as shown in the engraving, the height of the mountain would be 900ft. In connection with this subject, though, I may perhaps be allowed to refer "Penmaenmawr" to a letter of my own, 20518, on p. 60 of your XXXVIth Volume.

In reply to query 52385 (p. 292) Argelander's Durchmusterung is the Bonn Catalogue, and is contained in Vols. III., IV., and V. of the "Astronomische Beobachtungen auf der Sternwarte zu Bonn." It includes every star down to the 9·5th magnitude down to 92° N.P.D. It is accompanied by maps of all the stars contained in it. Besides this, Argelander's "Uranometria Nova" shows, in a series of 17 maps, all the stars visible to the naked eye down to 116° N.P.D., with the magnitudes carefully distinguished. This was published in Berlin, but, I should think, might be picked up through one of the London foreign scientific booksellers.

A Fellow of the Royal Astronomical Society.

SPECIALISM IN ASTRONOMY.

[22098.]—I quite agree with Mr. Gemmill in his remarks (letter 22036., p. 239 Vol. XXXVIII.) on the growing tendency to specialise astronomical work. Astronomy is, as I have found, distasteful to many, from the fact that a great number judge it to be, for them, hopelessly involved in abstruse forms and technicalities; whereas, in fact, it is, in some of its simpler aspects, one of the most interesting and attractive of the sciences. This mistaken idea no doubt arises in a great degree from what Mr. Gemmill points out, and, as he says, much valuable aid is thus lost—a circumstance which is to be lamented. Now, it seems to me that if at times a little more emphasis were laid on the "common" work, which may be done with the naked eye, or with optical means at the command of almost anyone, much valuable assistance would be given towards advancing the study of astronomy. If a student becomes impressed with the idea that he can do little or nothing towards gaining freedom in his subject unless he may at once consult high authorities and command a first-class telescope, it is not likely that his progress will be very encouraging; yet this danger threatens him in no small degree, for at every point he is confronted with the work which may be done with a telescope, while what may be done without one or with one he would be apt to despise, is left very much for him to guess at. Now, if without pining to split or elongate double stars, or to do any other of the minutiæ of telescope work (all of which is valuable in its own place), the young observer were to use the good means he possesses, and turn his mind to what lies immediately before him, he would have every chance of gaining a most encouraging range and scope in his subject, and the time spent and the work done would be anything but profitless and worthless. I am aware that such work is, by some, looked down upon as rather trivial; but, to my mind, it does not appear so. The subjects of stellar light and stellar variation, both of which can be pursued to a large extent with the naked eye, or with very small optical means, are important and valuable, and in the latter especially, as Mr. Gemmill well points out, much is to be discovered, and consequently much may be expected; while in the matter of star colours, I think there is room for anyone proceeding on a thorough and well-grounded method to establish at least something. In any case—and this is the main point of my remarks—such work, from its nature and breadth, and related as it must necessarily be, mainly to young observers, would go far towards reducing that tendency to specialise which Mr. Gemmill laments, and which I cannot but think unfavourable to the advancement of astronomy.

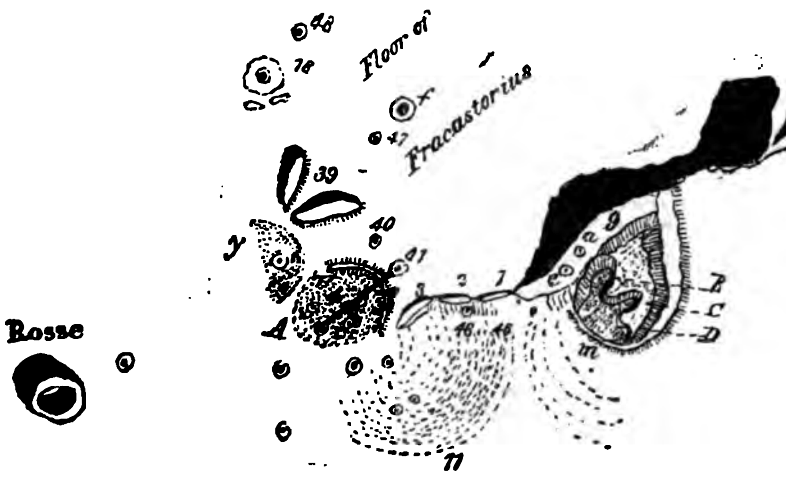
I cannot just agree with Mr. Gemmill in his estimates of *α* and *ε* Ur. Maj. All my estimates, which, I may mention, are quite recent, show these stars nearly equal, but make *α*, if anything, the brighter. However, they differ in colour, and may therefore differently affect different eyes, though I think that would hardly account for an excess on one side of three-tenths of a magnitude. In "Celestial Objects" Alcor is given of the 5th mag. Can any of your correspondents say if this star is *known* to be brightening? I generally pick it up in twilight from 6 to 8 mins. after *ζ* becomes visible. As other stars of the same magnitude, or even brighter, cannot be seen so early, I think that either the estimate in "Celestial Objects" is too low, or else the exact position of the star being known, it is more readily detected—probably the latter. In pausing, I may mention that some excellent lessons may be laid to heart during twilight observation of stars. I have frequently noticed that in an apparently clear blue sky, the fainter stars blink in and out, and the brighter ones constantly vary in lustre, illustrating, I suppose, the presence of haze quite insensible to the eye—a circumstance worthy of note in reckoning star magnitudes. Deeper haze, again, often changes the colour of the stars altogether—and this too is worthy of note. For example, on Nov. 11th, Vega at 4.45 p.m. seen through the faint rosy mist of a clear but windy sunset, was a beautiful pale emerald. It would seem that red or dull stars assert themselves in twilight quite as early as blue or white ones, though at present I would hardly venture to make a generalisation to that effect.

On Nov. 3rd, about 8 p.m., I looked at Saturn with a field-glass (2in. o.g.), magnifying about 25 diameters. I saw the ring easily with the dark sky distinctly visible through the *handles*. The body of the planet seemed to be of a whiter yellow than the ring. I thought I glimpsed one of the moons a little below [non-inverting glass] and to the south of the planet. This observation is of no importance, and I mention it simply because I think that when Galileo said he saw a large globe between two smaller ones, he hit the appearance of Saturn in a small telescope to a nicety. Webb says he has seen the ring with 20 on 1½in. aperture, and then adds, "though Galileo's glass magnifying it 30 times, could not define it thus"—of course it should be remembered that Galileo was groping in the dark.

On Nov. 13th the main group of spots on the sun was quite visible to the naked eye; and on Nov. 19th no less than three spots could be seen with the naked eye on different parts of the disc—one the group of Nov. 13th. **Orion.**

FRACASTORIUS — HORROX — CRATER BETWEEN THEOPHILUS AND MAEDLER.

[22099.]—I have read with very great interest letter 22035, No. 973 of the English Mechanic, on Fracastorius, from your clever correspondent, Mr. Thos. Gwyn Elger. His drawing of this formation as a whole supersedes, in my estimation, any yet published in your pages. As Mr. Elger kindly alludes to a cleft of mine, shown on page 405, Vol. XXIII., allow me to say a few words about its discovery. I first saw it, with another, on the E. on April 21, 1874, 8h. to 11h. p.m. I then wrote in my observing book: "Fine night, though at times the air is somewhat tremulous. Telescope driven by sandclock. The cleft *a* (the one on the E.) seen first, is easy when the air is quite still. It runs from between craterlet 30, and the E. large crater on the wall to a point between mounds 31 and 32 on the N. This is cleft *a*. While observing it, another cleft, *b*, came into view, and was not quite so easy. It was, however, well seen from crater c to its junction with cleft *a* and about its middle. The portion of cleft b from crater c to mound 5 [illegible] was [illegible] and requires other observations. It would appear from this that Mr. Elger's [illegible] corresponds to the eastern portion [illegible] that the remaining portion, [illegible] escaped him, for his cleft φ does not [illegible] with that portion of cleft [illegible] the place occupied by Mr. Elger's [illegible] I have on several occasions seen a *white* [illegible] in which were several minute craterlets. For aught I know, this may be a real cleft, and deserves attention. The number of small details which a good 8½in. mirror can reach is so great in studying such large formations as Fracastorius, that I have resolved to limit myself to only a portion when occasion to observe it offers. The sketch I here send represents the first, and, as yet, unique, of these portions. It represents the N.E. border of Fracastorius, and agrees very fairly with the same portion in Mr. Elger's drawing. Its only value consists in the fact that it contains details of objects not yet [illegible], so far as I know. I have marked the formations A, B, D and Y of Mr. Elger's; but it would have been well if your correspondent had used the symbols already published to designate objects identified by him. At the telescope, I know [illegible], but when preparing for publication [illegible] I wish to draw attention to [illegible] depression A, which [illegible] craters it contains with [illegible] Fracastorius shown by Mr. Elger [illegible] same direction as my [illegible] Fracastorius, [illegible] whether there is [illegible] elongations [illegible] may be [illegible] yet been seen [illegible] when observing [illegible] whether any [illegible] always [illegible] I have seen myself [illegible] as far as [illegible] very little [illegible] system of [illegible] known that [illegible] known to [illegible] relation [illegible] hand and [illegible] on the [illegible] and the second [illegible] the attention [illegible] where I [illegible] for they [illegible] observers [illegible] the [illegible] I always see [illegible] in a good [illegible] they [illegible] crown [illegible] but rough, [illegible] craterlets [illegible] however. [illegible] precludes the [illegible] their north [illegible] coming from [illegible] a ridge would have [illegible] A, B, C as closed all [illegible] are two [illegible] Schmidt, but which I [illegible] of his map, N. of [illegible] and Schmidt gives [illegible] from *f*. The two [illegible] much closer to it. 18 [illegible] of which there is a [illegible] seen the same, but [illegible] Schmidt's map, seems to [illegible] formation *y* is not shown either by Schmidt or Elger. Besides the craterlets being given, I saw 39 others in the Mare Nectaris, on Sept. 5, 1882.



Horrox.—I hope the eye of observers is kept on this formation, Dr. Julius Schmidt writes to me, that on March 15, 1875, with the great Berlin refractor, he saw three abnormal craters in the plane of the western interior ridge. Since I sent him my observation of Oct. 9 last, he has made five sketches, which he has kindly sent me, and which remarkably agree with what I see. On Oct. 21, 15h., when the eastern shadow had reached the middle of Horrox, Dr. Schmidt drew a dark spot at the foot of the western interior ridge, exactly at the place shown by me, so that this object is seen as a dark spot like a hole *both at rising and setting sun*. It is well to note this because, observing Horrox on Nov. 9, 1883, at 6h. p.m., I saw the same dark spot distinct from the shadow of the western wall and in front of an opening in the interior ridge; but at nine o' clock on the same evening a point of shadow coming from the western wall of Horrox had penetrated between the opening of the interior ridge, and had doubtless reached the dark hole, as no distinction could any longer be made between it and the shadow of the western wall. Closely surveying, then, the western wall, to know the cause of this pointed shadow, I saw a peak projecting eastward from the wall. The dark hole, or dark spot, might then, at times, be ascribed to the shadow projected by this peak, when the sun rises on the moon, and the shadow goes from W. to E. (though even then the dark hole can be seen when the western shadow has not yet reached it), but it is impossible that this can take place when the sun sets, and the shadow goes from E. to W. It seems, therefore, that there is here, at the east side of the interior ridge of Horrox, a dark spot, or dark hole—a crater without border—which had not been seen before Aug. 11, 1883, when my attention was first drawn to it.

Crater beween Theophilus and Mädler.—On Nov. 14, 1883, at 5.30 a.m. I saw between Theophilus and Mädler a very distinct and white crater, not given by Schmidt, who gives in this neighbourhood other craters much more diffiuclt to see. If the "wire" of the minometer is placed a little N. of crater B on the N. slope of Theophilus, and directed to the N. border of Madler, this crater will be seen along the line at equal distance from Theophilus and Mädler. The terminator was passing through Goclenius at that time. Next morning, however, when the terminator had encroached on the western border of Mare Nectaris, the whiteness of the crater had disappeared, and was itself rather difficult to see among the various ridges situated in this region. Would some one say if this crater is given by Schroter, Lohrmann, or Neison, or has any observer seen it already? It was an easy object, and attracted the eye at once when first seen.

I can assure Mr. S. Maitland Baird Gemmill that if my communications on selenographical matters have become unfrequent of late, it is only on account of unfortunate circumstances entirely independent of my own will. May I be permitted, at the same time, to thank him for the favourable view he takes of my labour in selenography?

β Delphini, δ Equulei, and γ^2 Andromedæ.—On every available occasion I have looked on these doubles. With β Delphini, I obtain the same results as before stated. As to δ Equulei, I have not had weather sufficiently good to satisfy my eye when using a power above 300. However, through frosty, unsteady air, I think I may say with certainty that the *comes* lies between 300° and 310°. Perhaps "H. S." will say if I am far wrong. γ Andromedæ now comes into very good position, and will certainly draw the attention of all those who possess instruments sufficiently powerful and good to compete with it. As for myself, all I can say is that I elongate it readily with any power from 180 upwards, position 100°+. I thank Mr. Perry for his measures of β Delphini, and I look for those of δ Equulei which he has kindly promised to give. Perhaps he will also tell us something about γ^2 Andromedæ. It would have been interesting to hear from him how β Delphini looked in his fine large mirror—i.e., if the *comes* was neatly separated; if the space between the two stars was comparatively large, and the power he used. My impression is that δ Equulei is more difficult; but of course my opinion has no weight at all—my mirror being only an 8½in. one.

Nov. 22. **C. Gaudibert.**

SELENOGRAPHICAL—FRACASTORIUS.

[22100.]—In reference to "M.A.'s" flattering notice of my drawing of Fracastorius (letter 22072) of the five crateriform objects shown on the N.E. side of the formation, I have only seen the ring complete in one instance—viz., in the case of that marked E, which is found at the termination of the long ridge that extends in a N.E. direction from Fracastorius *d*. Schmidt shows B, C, D, and E as perfect rings. B. and M. represent E as truly circular with a central mountain. Lohrmann also shows it complete. In the Rosse drawing, under date 3rd October, 1860, 4h. 30m., A, B, C, and D are depicted as in my sketch, open towards the N., while E is drawn of an elliptical shape. There are several small craterlets between Rosse and the N. border of Fracastorius; but I find that they are usually more easily visible under morning illumination. None of them, however, can be compared in point of magnitude to that shown in my drawing on the ridge connecting Rosse with the western wall of Fracastorius.

November 30. **Thos. Gwyn Elger.**

EQUATORIAL STANDS.—II.

[22101.]—Since my last, I have been endeavouring (before further entering into the details of those already described), to work out a stand of a different form to the usual patterns, which should, while fairly easy to construct, combine some of the conveniences of more elaborate contrivances. It is not intended to aim at the niceties of construction found in expensive stands; but I trust the illustration and the following description will show that essentials have not been neglected.

The circular base B, and the ring C C (of "I" section) are in one piece, as well as the web-plates or gussets at K, L, and M, and this foundation frame is proposed to be of cast iron. The ring C C is thickened out into cylindrical sockets at D, E, F, and H, to serve respectively for the holding-down bolt, for the bearings of the polar axis, and for a clamping screw. All these sockets, except that for the holding-down bolt, are intended to be bushed with brass.

The gusset-pieces L, M, carry a disc (part of the casting), which serves to support the hour circle O O. This circle is, in fact, a stout brass cap or ring fitting over, and turning pretty stiffly round on the cast-iron disc, just as the cover might be turned round on a wooden box. To facilitate this rotation the lower rim projects somewhat, and is milled on its edge.

Above the hour circle is the disc R, either cast in one piece with it if the polar axis is of brass, or solidly attached to it if it is of iron or steel, and having on its edge an index and vernier to read the hour circle by. This latter disc carries the two supports in which the declination axis turns as usual, the clamping-screw inserted in one of the supports serving to fix this when desired. Though not so shown, this clamping is best done with a split bearing.

The declination axis carries at one end the bar P, to hold the telescope, and at the other end the declination circles and balance weight. Of the two declination circles the inner one is fixed to the support; the outer one is free to turn on the declination axis, but can be clamped by the milled-headed nut against a shoulder formed on the axis, with which it will then turn.

The large V-grooved disc fixed on the middle of the polar axis is merely shown as intended to be clamped by the conical-ended screw, thus preventing the axis from rotating; but, if preferred, this disc may be made to serve as the hour circle by having an index and vernier fixed to the stand. It would then be advisable to have it loose on, but arranged to be clamped to the polar axis. I think, however, the hour circle is more convenient where shown. The base-plate B has three stout bluntly-pointed studs projecting from its lower surface; these rest in three conical holes in the underplate A A, which latter plate is fixed on the top of the oak or iron pillar.

It is thus easy, by unscrewing the centre holding-down bolt, to lift off the entire stand, *and to replace it exactly in the same position*. These studs are tapped (a very tight fit) into the baseplate B, so that by screwing them up or down, a certain amount of adjustment is obtained when first getting and this axis is often continued *through* its frame and made to project *both* ways, so that the handle can be applied to whichever end is most convenient.

Next we come to clamping arrangements (verniers had better be left for a future letter), of which there are several kinds. At first sight it seems easy to clamp two discs together, or to clamp an axis to prevent its turning, but it is less easy to do this *effectively* than it appears. Fig. 3 shows the simplest contrivance, merely a screw (a "set-screw," in fact) inserted through the side of the socket and jamming the axis inside it. This, though often used, is very defective, as the clamping action is too feeble to resist even a slight force tending to turn the axis round in the socket, and the usual result is a polished groove worn into the axis by the point of the screw. Next we have in Fig. 1 a collar embracing the axis, or spindle, which collar can be closed tightly round it by the clamping screw. This screw is made with a flat handle to enable it to be more firmly grasped. This clamp, though far superior to the set screw, is still liable to slip when, in course of time, the inside of the collar and the outside of the spindle get mutually polished and lose their frictional "bite." By the way, the tangent screw in the figure should have been shown more nearly parallel with the clamping screw, for though it changes its position and thereby partly rotates the balls through which it passes, it would be almost parallel with the clamp screw when half through the ball nut as sketched.

If is self-evident, speaking of clamps in general, that the farther the clamp is removed from the central axis of the wheel or disc, the less is the force required to restrain the wheel from turning, and for this reason *rim*-clamping is, when practicable, far preferable to *axis*-clamping.

Even rim clamping may, however, be (sometimes as) badly contrived, of which Fig. 4 is an illustration. In this instance there is a liability to bend one or both the discs when the screw is tightened up, and if these are too rigid to yield, a strain is put on the axis which carries them.

In Fig. 5 this is avoided, as the screw merely tends to pinch the edge of the rotating disc between itself and the upper jaw of the clamp. In practice it is usual to introduce a loose piece between the end of the screw and the underside of the disc, which prevents the screw indenting it, and also increases the surfaces in contact and gives more grip. Various modifications of this are in use. Sometimes there is a square or V groove to receive the loose gripping piece, but these need not be separately considered.

In the "Popular" stand a V-grooved disc is clamped by the pointed screw, and as the clamping is at the rim, the force required is small; while to prevent any bending of the polar axis under even this slight strain, the axis is made pretty substantial. *As a rule*, no axis liable to bend should be subjected to cross strain by the action of clamping. I have seen double-jawed clamps like a vice, but with both jaws movable: these avoid all strain on wheel or axis, but are troublesome to fit up so as to be free from shake. **A. S. L.**

P.S.—Since sending my former letters to press I have formed the division of the polar circle into 24, and the consequent long vernier (or quasi-vernier) has been suggested by another correspondent—See page [illegible], Vol. XXXVI.

NOTES AND QUERIES ABOUT THE TELESCOPE.

[illegible]—As so many readers of the "E. M." take an interest in the telescope, I have thought that a few notes and queries in reference to matters of real interest might not be unacceptable.

I shall begin with a query. Observing in this periodical that Mr. [illegible] in resilvering his great mirror had used glucose as a reducing agent, I have to ask whether any of the many readers of the "E. M." have tried that reducer, and, if so, if they have found it equal in the deposit it produces to the reducing agent recommended by our valued Transatlantic correspondent, Mr. Brashear, of which the main ingredients are sugar and nitric acid. I have tried Mr. Brashear's process and find [illegible] would wish to have the opinion of [illegible] in Mr. Common's process.

[illegible] In a German journal [illegible] für [illegible] there is a very interesting and seemingly impartial account by Dr. Klein of the performance of a refractor of [illegible] aperture. I give a translation of the most interesting parts of Dr. Klein's statement. He mentions that [illegible] worked with a dialyte of [illegible] aperture [illegible] the fine definition of which [illegible] instruments of much larger [illegible] the exhibition of the most minute [illegible] However, in order [illegible] to get more [illegible] he was induced to order a refractor [illegible] from Reinfelder and Hertel [illegible] that firm [illegible] an instrument of six inches aperture [illegible] which would be entirely satisfactory in respect both of achromatism and definition. The telescope was accordingly made and delivered to Dr. Klein, who observes that the testing of such an instrument is a very delicate affair, requiring above all a great deal of time, and he states that he had used it for two years before giving a definite opinion in regard to it.

He says, in speaking of its performance, that it has a secondary spectrum of violet blue. The light of the instrument was the first thing to strike him, and quite surprised him. He had repeatedly seen with it the companion to Sirius, as also the second moon of Saturn, Enceladus. It showed the feeble satellite of the Comes to Beta Equulei clearly at its position angle of [illegible], though he was not previously to the observation aware of its position. With this instrument he was enabled to recognise in the Nebula of Orion those delicate gradations of light and shade which are represented in Temple's masterly drawing. He sees the 5th star of the Trapezium, but has not hitherto been able to detect the 6th star. *In the course of last December* (i.e., the December of 1881) *there repeatedly appeared to him to be a minute feeble star twinkling in the middle of the Trapezium* (uebrigens kam es mir im vergangenen December wiederholt vor, als flimmere in der Mitte des Trapezes ein schwaches Sternchen). He adds that he does not doubt but that under favourable conditions the 6th star of the Trapezium would be also visible in his instrument; but he cannot credit those who allege that they have seen both the 5th and 6th stars with apertures of 4in. or even less.

In the case of η (Eta) Orion, the principal star with a power of 550 is widely separated from its companion, and the interval between them is equal to about half the diameter of the star discs.

The equatorial belts of Saturn are, under favourable conditions, shown covered, as it were, with light clouds. The ring shows Cassini's division (that is, the principal division) very sharp, but of Encke's division he has till now only seen traces at the ansæ (habe ich bis jetzt auf den Ansen nur Spuren gesehen). When the air is good the limit of the dark or crape ring is very distinctly defined *on the side next the planet*; on its side next the bright ring he cannot observe any separation between the dark and bright rings, and he does not believe that any definite separation exists.

Jupiter shows a multitude of details, but in the case of this bright planet the violet halo of the secondary spectrum is extremely noticeable (äusserst augenfällig). The same holds true for stars of the first magnitude.

He has, however, chiefly used the instrument for observation of the Moon. With a power of 550 the multitude of details observable on the lunar surface is so great that it would be an endless task to enumerate them.

So far Dr. Klein. I would remark, by way of note, that it seems strange that Dr. Klein should have repeatedly seen what appeared to be a feeble star in the middle of the Trapezium whilst he admits that he could not see the 6th star. In reference to this star in the middle of the Trapezium, the following curious corroborative observation appears in the *Observatory* of March, 1882, in the shape of a letter from Mr. Byles:—"Professor Hall states that he was not able to detect a star within the Trapezium. Some years since, my friend, the late W. Bateman Byng, formerly member of the R.A.S., was observing the Trapezium with power of 400 on a Ross 4¼ object-glass. He exclaimed to me, 'Look, look! You see an *indistinct* star in the centre of the cavernous sky beyond our system, and in the depths of eternity.' And so I did.—Jeremiah Byles, Ipswich, December, 1881."

Can it be that this central star, which has not been seen with large apertures, is surrounded with a nebulous halo, and so, like the nebula in the Pleiades, is best or only seen in instruments of moderate apertures? Or is it a variable star? Or finally, is it an illusion, occasioned by coruscations from other stars in the Trapezium?

In regard to the colour shown by the Munich refractor when directed on Jupiter and stars of the first magnitude, it seems to me strange that an instrument otherwise so good should be defective in achromatism. I have two refractors about 4in. aperture, and they both show Jupiter and the largest stars free from colour, though in regard to double stars they have no great separating power.

It will be seen from the far too short notice given by Dr. Klein of the performance of a dialyte by Plössl that continental makers have made excellent telescopes of that construction, while, singular to say, English opticians by their own confession have failed in making good dialytes. By the way, should this meet Mr. Bradbury's eye, I would wish to ask him if there is any particular virtue in the curves of long focus given by Professor Smith in his account of his dialyte—viz., for object-glass one radius [illegible], the other radius [illegible] focus [illegible]. Would not a plano-convex of the same focus—viz., [illegible]—theoretically answer as well? Again, for flint corrector, one radius is 161·1in., the other 9·973in. Would not a plano-concave of, say, 10in. radius for concave surface do as well? Otherwise, it will be difficult to get opticians who have tools to give the particular curvatures specified by Professor Smith.

In this connection, I would mention that while Dr. Klein could not see the 6th star of the Trapezium with an ordinary 6in. achromatic, Professor Smith states that with his dialyte reduced to 6in. he saw both the 5th and 6th stars of the Trapezium. We may infer from this that the dialyte is at least equal in light to an ordinary achromatic of the same aperture. Meanwhile, I desire to cordially thank Mr. Bradbury for the valuable information he has given us respecting that instrument.

Having propounded the above queries, and made the above notes, I take my leave. Before doing so, however, I must record my grateful acknowledgments to Mr. Wassel, whose elaborate papers on the figuring and testing of specula appear to me the most valuable contributions to the practical construction of the reflecting telescope that have ever appeared in this or any other journal. They well deserve to be republished in a separate form.

James Dunlop.

Bonnington-bridge, Edinburgh.

TRICYCLES.

[22103.]—Your correspondent "E. B. S.," in last week's issue, refers to various chain and direct-action machines, but does not even mention cog-wheel action, which is surely as important as the former methods. I now ride the "Folding Excelsior," and find it splendid for all-round work. This part of the country is very hilly, but I find no difficulty in keeping up with double-drivers, and down hills can keep even with all the front-steerers I have seen. On level ground it is not so fast as some other machines, for, being geared level, the very quick pedalling required is tiring after a while; but its great breadth, and length of backbone, make it remarkably safe down hill, enabling higher speeds than eight miles an hour to be indulged in with safety.

"E. B. S." is right about the brake wearing away, as it frequently requires to be renewed; but the tires ought not to be replaced in less than four years. I cannot agree with him about back-pedalling, for having several times met restive horses that would not pass my machine, I have had to go back when there was not time to turn. Besides, back-pedalling up hills is a great help in certain cases.

"E. B. S." says the narrowness of the Coventry "Rotary" is a disadvantage when turning corners, although convenient for entering narrow doors. The "Excelsior," having the folding arrangement, has this advantage over the "Rotary," that it will go in a narrow door, and yet is so wide, when open, as to be quite steady round corners. Of course the folding framework adds weight, but that is turned to account by the greater stability obtained.

A letter from "D. H. G." would be welcome now, and I should be glad to see the opinions of other riders of "Excelsior" machines.

Ventnor. **C. J. Ryan.**

[22104.]—To "Y. B." (22056, page 264).—With reference to this matter, although I am not a tricycle rider, I should think a level geared 48in. Premier front-steerer, about 80lb., or other of the same type, would suit. A band brake is preferable. "Y. B." has evidently not had enough practice on the Otto. It is not to be learnt in a few days. By this I mean that a beginner cannot expect to become an accomplished rider in such a short time. In learning he finds that he can first ride on the level fairly, but not up hill. This is because he is not very confident about his balance, and consequently does not ride so vertically as he would later. This only comes by practice, and if "Y. B." will persevere, in a little while he will discover and appreciate the good hill-climbing qualities of the Otto. He will by this time, by using the straps, and, riding almost vertically and with their assistance, be able to ascend any hills that tricycles of like gearing can, and probably some that they can't. I should like to take this opportunity of stating very strongly that when riders publish hill-climbing feats, they should mention the gearing of the machine, as I am sure many are geared down. I have not yet heard of a tricycle geared 56 level ascending Muswell-hill, though I read the cycling papers. The spinning round that "Y. B." complains of may come from two causes. He either turns the steering handle a little without thinking, or in back pedalling one of the bands might slip if they were at all slack. It may be laid down as a rule that the handles should be turned inward when back pedalling; but if the machine is properly adjusted the brake alone will be powerful enough. The bands, if not lined, are liable to slip in wet weather. Screwing down the springs a little will tighten them. I have never heard of one breaking, and should think it quite impossible with ordinary usage. If one did, I might be the result. To guard against this, I fix a thin piece of wood as a shield, which would not only protect the hand from the point of the tool, but which also, being inclined downwards, catches the water occasionally thrown off by the tool and returns it into the trough of the grindstone.

M. A.

WIMSHURST V. VOSS INDUCTION ELECTRICAL MACHINES.

[22111.]—In an earlier number of your excellent paper I noticed certain comparisons drawn between the above machines, and I saw a suggestion thrown out that a trial of their respective merits should be made. I have, since that time, seen no further notice of that trial, and as I was anxious to obtain information on the subject I had two sample machines made.

After a series of trials with these in all states of the weather, I have arrived at certain conclusions which I thought might prove interesting to the readers of the English Mechanic.

The glass plates of the influence machine are 14in. in diameter; those of the Voss are 16in. and 18in. respectively—the 16in. plate being, of course, the one which revolves. Both machines are made according to orthodox patterns, the directions for the influence machine as taken from *Engineering* being the inventor's own as far as I know.

I made a comparison of the machines on the following points:—

(1) The ease with which the current is generated.
(2) The liability to redistribution of the electricity on the plates.
(3) The intensity of the spark.
(4) The quantity of current evolved, as tested by the time taken to fully charge a Leyden jar.
(5) Length of spark.
(6) Ease of manufacture.
(7) Stability of the machines for the purpose of carriage.
(8) Cost.

I obtained the following results:—

(1) In perfectly dry conditions of the atmosphere, or as nearly dry as we can obtain, both machines start as soon as the plates begin to revolve. But when the air is more charged with moisture, the influence machine starts much more readily—that is, it requires fewer turns of the plates before the current is induced.

(2) The distribution of the electricity on the plates of a Voss machine is one of the most annoying points in the machine, for it is constantly varying, and the slightest circumstance, such as slackening or increasing the speed, will cause the electrodes to change their polarity—a change which, when one is working with different sized terminals to the electrodes, and exhibiting the electric discharge either in the form of a spark or a brush, causes great inconveniences in an experiment.

With the Wimshurst machine, I find that the polarity of the electrodes remains unchanged as long as one works the machine.

(3) Despite the smallness of the plates of the Wimshurst machine, the intensity and thickness of the spark is far greater than that produced from the Voss machine, and the report of the spark is far louder.

(4) I fill the same Leyden jar from the influence machine in half the time that I require when using the Voss machine, with the plates running at the same rate of speed.

(5) The length of the spark obtainable from the Voss rather exceeds that obtainable from the influence; but differences in insulation and in the size of the plates must be taken into account.

(6) In the ease of manufacture—"a great point with amateurs"—the influence machine, from the smaller number of parts and the greater simplicity of design, appears to me to be the most valuable, though merit must be given to the Voss machine for greater style in appearance, which is a point, however, that is not by any means an essential in an instrument intended for work.

(7) The stability of the Wimshurst machine, as shown in the ease with which it can be transported without fear of breakage, and in its compactness, without, at the same time, a sacrifice of insulation, far exceeds the stability of the Voss; for unless the fixed plate of the Voss is very firmly held, and with such insulating materials as vulcanite, which much increases the cost, the machine is very liable to breakage.

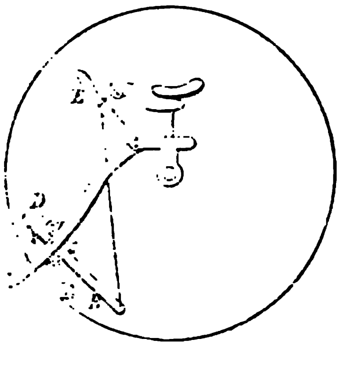
(8) As there are far less working parts and greater simplicity in construction, the cost of manufacture of the influence machine is necessarily less than the Voss.

I have made these experiments in an entirely disinterested spirit with a view to gaining information for myself, and I have tried to act fairly in judging the merits of the two machines; but every test has gone to prove to me the superiority of the influence machine in nearly every point, and as a machine for classroom, laboratory, or lecture table *I consider it* invaluable.

November 27th. **A. J. Walter**, Dulwich.

SIMPLE AUXILIARY POWER FOR TRICYCLES.

[22112.]—This is not intended for application to tricycles in the course of manufacture, but as a simple addition to tricycles already in existence, but without hill gearing. As will be seen from sketch,



it can be applied to either front or rear steering machines, though this is supposed to be a front steerer—a "Salvo," for instance. I should very much like to have the opinion of such as "D. H. G." and others competent to judge. I don't think it needs much explanation.

A, ratchet wheel 6in. diameter; B, lever 18in. long, working freely on same shaft by pulling handle C, which is attached to lever by catgut cord; the pawl engages with the ratchet and helps the feet; when not required it may be thrown out of gear by placing the toes on pawl at D and drawing it smartly back, which will cause it to revolve till the pin at the end of pawl rests on lever; the ordinary purchase handle may now be used, and the machine will run without any extra friction. The position of pawl when out of gear is shown by dotted lines; a smart tap with the toes from beneath throws it in gear again. Of course, the same arrangement can be fitted to both sides of machine if desirable.

E. P. R.

KEY CHARACTERISTICS OF MUSIC.

[22113.]—I must certainly object to the statement of your correspondent (letter 22068) that "it is entirely through defective tuning that the key characteristics arise," as I have frequently noticed they are very clear to me when the instrument is very carefully tuned to equal temperament.

As a practical tuner I must also take exception to what he says about "an experienced tuner's ear," the great point being to get the circle of fifths equally flat, independent of any scale whatever. But supposing they are perfect, as he seems to imply (evidently he does not mean them tempered), then, before he gets very far, he will find his thirds getting very sharp and his "six keys" anything but well tuned. The E will be too sharp for the key of C, and the B still worse for G, &c.

Again, supposing he is right, all tuners must take the same plan, or what becomes of the peculiarity of each key?

Sutton in his "Elements of the Theory of Music," page 41, says:

C is bold and massive.
D strongest of all keys.
E flat warm and beautiful.
E bold rich and clear.

In regard to the inequality of semitones, I hope the "experienced tuner" would not leave them so unless ordered to do so, as it is not equal temperament at all, and the instrument is not in tune in all the keys.

I seem to feel something of the characteristics when playing myself, but not when other people play, and I also find that if I test those who appear to hear them strongest, by modulating in a roundabout way to destroy the tonality, so to speak, they very soon mistake E-flat for E-sharp, and make soft flat keys bright sharp ones, and vice versa.

That there are some peculiarities in them I should say there can be no doubt, but I do not think it lies in the direction pointed out by Mr. Hardie.

H. Gnidrah.

[22114.]—I think if Mr. Westwood Oliver (p. 283) refers to Helmholtz again, he will find that the distinguished German meant musical keys on a justly-intoned instrument. To sensitive ears the keys on equal-tempered instruments are, no doubt, readily distinguishable; but if any one can detect the difference on say, Colin Brown's voice harmonium, or on a violin played by a master, it can only be by a nice appreciation of pitch, for the keys on justly-intoned instruments are all alike, except in pitch. It is not much use to speak of orchestral music, for even with the most expert players, the instruments are never absolutely in tune during a whole evening's performance. Surely Mr. Hardie and Mr. Westwood Oliver know that this question of key characteristics was thrashed out in Vols. XX. to XXVI. (I think) by, amongst others, the late Capt. J. Steel, Rev. H. C. Key, and others.

N. E. Child.

THREE-MANUAL REED ORGAN.

[22115.]—In No. 969 of "ours," you illustrate a design for "three-man. reed organ," by "Joiner." Now most exhaust instruments are heavy of touch. In looking over "Joiner's" sketch the same result would seem to happen. There is the great organ with two or more pallets to each key. Then great to swell makes a 3rd and to swell oct. a 4th pallet. What will "Joiner" do to keep the touch from being heavy? I should like to know, as I contemplate a two-manual of about nine rows.

It would seem that the two tubeboards to great, which he places vertically, and each under its own pallet, might be placed under one pallet if channels of suitable proportions connected both tubeboards, with the pallet apertures half-way between. The reeds might not speak so quickly—I don't know. Has anyone had experience on this arrangement which they can give? "Joiner's" notice of this will oblige.

Leinad.

EXTRAORDINARY MESMERIC SLEEP.

[22116.]—In view of my former letter (p. 174), I have the pleasure to inform "Sigma" and all other friends of the "E. M." that on Tuesday, the 20th ult., at the Glasgow Western Infirmary, the great Dr. Nature waked up Mrs. McInnes from her long sleep of *nearly half a year*.

Slowly but surely must come the waking up of the world itself to see in sleep a much higher conservation of energy than we at present dream of in our philosophy.

May I ask "Sigma" and other thinkers to give the "E. M." their best thoughts on "What is Sleep"? Also, to give their *philosophical* rendering of the following two lines on Sleep from the inspired and inspiring Shakespeare:—

"Balm of hurt minds, great nature's second course,
Chief nourisher in life's feast."

Edinburgh. **J. D. Morrison.**

"HIDDEN LIGHT."

[22117.]—

"When yawning with my eyelids closed"
(Pray do not laugh),
I saw a light which I supposed
Was P, of which the brain's composed
[Per cent. "Saul Rymea's" disclosed
One and a half].

Newton and Huxley when they pressed
With finger nail
Their eyelids had their vision blessed,
As you no doubt 'ere now have guessed,
With gorgeous spots in colours dressed
Of Peacock's tail.

But when I try the self-same game,
With like intent,
Instead of tails of feathered game
I'm dazzled by a sunbright flame,
Although I try the very same
Experiment.

John Scott.

COILS—CHUCKS—DISSECTING NEEDLES—FISH VERSUS FLESH, AND THE ILLS THAT FLESH IS HEIR TO—RUBBER NOSES—FRET SAWS—OXYDISING SILVER—REMOVING SOLDER—POLISHING AND BENDING BRASS—"NOT TOO EXPENSIVE" BUILDING.

[22118.]—I have not sufficient impudence to call myself an expert in coil building, but I will say a little about Mr. Harcourt's coil (22088). Now, the first thing to be considered in the construction of such a coil (or indeed any other) is to get all the wire as near as possible to the coil as near as can be made compatible with *sufficient* insulation. Between each layer of secondary, Mr. H. places $\frac{1}{16}$in. of paraffin, and I should say from his description about $\frac{1}{8}$in. of something else—nearly all of which is quite unnecessary; and more than that, it has spoilt his work. The insulation should be as thin and as perfect as possible. A certain thickness of insulation is very desirable between the primary and secondary coils; but the respective coils of each should be as close as possible, and the best insulator is paraffined tissue paper. This does not want soaking in the paraffin. The best way to make it is to spread the sheet of paper on a flat board or table, and with a (laundry) flat iron made hot melt a few spots of paraffin over the paper, and then iron it in. This can then be cut in strips of from $\frac{1}{2}$in. to 1in. wide ing to the size of the coil, ar like tape, using a hot knife to wards. The joints certainly ought to be soldered; but the soldered joint should be from 1in. to 1½in. long; if they are twisted and cemented the cement is very apt to run between the wires and spoil the insulation. The joint need not be covered, as it spoils the smoothness of the winding, and will not to any appreciable extent affect the coil. These remarks are not made from hearsay, but are the result of my experience, as I have built coils which compare favourably with any others made: but in any more which I make I shall use silver solder for all joints in the secondary. It is just as easy to use as the other and makes a neater joint, and is even a better conductor than the wire itself; soft solder is a bad conductor, therefore beware of using too small a quantity, which is probably the case with the neat joints spoken of by Mr. Harcourt. I fully coincide with both conclusions arrived at in the ultimate paragraph of his letter—14 or 16 would have been better for primary.

For chucking wood in the lathe (22072), I have for some years used the boxwood spring chuck lately figured by "O. J. L." For light work, the spring of the wood is sufficient to keep it in place. I sometimes secure the work with a bolt and nut, as figured by "O. J. L.," or by a wooden ring to screw on outside; rings or hollow work will hold very securely on the outside of these chucks. I have a habit of making a chuck to suit any special piece of work, and thus a large number accumulates, and the time soon arrives when a new one will be seldom required. I back them with pieces of sheet brass, ¼in. thick, tapped to fit the lathe.

A week or two since a correspondent sent a method of fastening needles in handles by splitting the wood and tying the needle in. Now, my way is to place the needle in the vice between two pieces of brass, or hold it in a pair of pliers (the eye need not be broken off) and then force it into the end of the holder; it will be very secure and answer every purpose. The end containing the needle is now planed down with a knife, which gives it the appearance of a pencil with a very long point. This is much neater than the previous method, and in my hands has given great satisfaction.

I have reason to believe that an ailment for which I recently underwent an operation was caused by a change in diet—namely, eating an increased quantity of meat. I am led to this by reading the remarks of Mr. Allinson. Excessive meat eating is really a vice of the worst description, and I feel inclined to place it next to drunkenness. It is all very well for people to say they feel hungry after eating anything else, as some workhouse people lately said after a fish dinner; but that is owing to an abnormal and depraved condition of the stomach. That feeling, after a time, goes off, and fish can be eaten with as great a relish as flesh. I would allow a greater latitude to a man whose occupation is hard manual labour, though these, by the bye, are generally those who can the least afford to buy meat. I would certainly recommend any man of sedentary occupation to try fish for a change, and meat not more than twice weekly, and that, rabbit or poultry. There is no doubt an immense amount of disease engendered by meat eating, and I can date my discomfort from the time that I commenced to eat meat twice a day. I now eat my supper of oatmeal and milk with greater relish than I before did the meat. I think Mr. Allinson will agree with me that fish is a lesser evil than flesh meat, and that a change to even a rational diet should not be too sudden.

Will "W. G.," page 271, kindly refer to my reply (52175) and then to the original query. He will find that I did *not* recommend indiarubber noses. I ventured an opinion that they were somewhat troublesome to wear. The query referred to caoutchouc, and to that I confined myself. Though well acquainted with the method mentioned by "W. G.," I did not happen to think of it.

My advice (if it is worth having) about fret saw' (52344) is, don't use any spring; it will not act quickly. It is better to have the saw extended on a frame similar to the "Holly" and some other machines. Querist signs himself a "'Decided' Amateur"; he seems, however, to be rather undecided; hence his query. Get a look at one or two machines. Many ironmongers sell them, and he will find lots of figures in back numbers.

"E. H." (52352) would do well to try a solution of platinum bichloride.

It is very difficult to give "W. J. L." (52357) much advice, as he does not say what sort of solder it is, whether hard or soft. If the latter, heat the article in any way till the solder softens, and then brush it off with a small brush or hare's foot. The only kind of work for which a candle is at all suitable is to solder gas-pipes, and I can do that much better and cleaner with a spirit-lamp.

"Jim" (52373) must rig up some kind of a lathe, and get a circular brush made as long as his brass is wide. He can either use a brush or a piece of wood covered with leather. Brushes wear out very quickly, but they also do the work quickly. He won't want a very elaborate lathe, as the pulley and brush can be mounted on the one spindle, and placed between anything in the shape of centres. Should think, however, that the roughness had better be taken off first by hand-stoning.

"Not Too Expensive" (52382) is the secret of very much decayed building work. Don't put on the cheapest thing you can get; you will find it the dearest in the end. I am not in the building line, but I should say Portland cement and sand; but whatever is used, nails should be previously driven into the wood to hold it. Should recommend "Jim" (52387) to get a piece of wood planed up on which to hammer his moulding. The proper way would be to have it rolled between two correctly-shaped rolls. It would, I think, cost him much less to have it done where the brass is made and rolled.

Os.

CABINET-MAKING.

[22119.]—An amateur who wishes to make a drawer, or a nest of drawers, need not be deterred from making an attempt because he thinks the dovetailing requires a practised hand. This is true no doubt when a thorough good job is required; but still, the amateur can turn out a neat and strong drawer with a little care. In choosing the wood, well-seasoned stuff ought to be got: the sides of the drawer and front will vary in thickness according to the size. For instance, if I were making a drawer for a sideboard the stuff I should use would be as follows:—Drawer front, 1in.; sides, ½in.; bottom, ¼in.; back, ⅝in. or ½in. But for a drawer for a small cabinet or nest as follows:—Front, ¾in.; sides, slight, ⅜in.; bottom, ⅛in.; back, stout, ¼in. Now to work. I shall describe a large drawer, say about 2ft. long; the following remarks will apply just the same for one 6in. square. Having selected the stuff, the first thing is to plane it up. Always have a sharp plane-iron, as this is the secret of a clean cut; plane up the way of the grain that shows the cleanest cut without tears; then mark, so that you will know which end you started to plane from, make this the front end, or that part which is dovetailed into the front. Having done this, then run them into the partition to fit. I make a practice myself of fitting in the sides just as easy as the finished drawer, seldom having to put the plane on top or bottom edges after the drawer is together; having done this, square up the front and back edges from the bottom edge, put another mark for the bottom edge; next thing fit the drawer front, the bottom edge, and the ends. Fit this in tight, so as to allow for a shaving or two to be taken off when finished; the best way to secure a good fit is to fit the front a little larger on front edge than the inside edge—that is, in shooting the edges get them a trifle out of square on the edges, but only a very little, just about a shaving. The idea for this is, allowing the smallest edge inside, a greater dependency can be placed in getting a good fit when finished. Having fitted these, plough out the drawer front to the depth of ¼in. or ⅜in. to allow for the drawer bottom; that is, make a groove about ½in. from the bottom edge. Then get the back, lay it down on the bench best side up; lay the drawer front on to this, getting the top edge of groove level with the bottom edge of back—that is, to leave the back narrower than the front, the ½in. and the width of groove, then marking the length of draw front. I would not advise the marking awl, but the point of a thin knife: this makes a cleaner and better cut; shoot the ends of back, leaving the mark just on; put a mark on the back of this, showing the bottom edge. Then get a thin-toothed cutting gauge, set the tool to the thickness of the sides, but a trifle less to allow for planing, mark the inside edge of front, set the tool again to the back edge of the side, mark the drawer back; having done this, set the tool to the front, working from inside to about ¼in. or ⅜in. from the outside edge. Mark ends of front, also with the same mark the front edge of drawer side, set the gauge to the thickness of the back, then mark back end of sides. Next thing is to make dovetail; first get the sides together, then, having put them in bench screw, make the first cut about ¼in. from the bottom edge; use as thin a saw as you can get—a great deal depends on this; the next cut about the same from top edge, next cuts about 1in. apart. In making these cuts care must be taken not to make the pins too large. In filling in for dovetails, make the next cut, bearing the saw a little to the left hand, start again in the same cut, this time bearing to the right hand; when finished it ought to be about $\frac{3}{16}$ at bottom of cut, or between the two cuts tapering upwards till the both meet in the one cut. Having turned the back edges upwards, do the same, but start the cuts from the top edge, the reverse way, and set the gauge to the width of groove in drawer front, namely, the ½in. and thickness for groove. Mark from bottom edge of sides; this gives the distance for the back to come, too, leaving the ½in. and the groove open to slide the bottom into. Get a sharp chisel and chop out the small parts of the dovetails. Mix up a little red ochre and water to a thin paste, put the draw front in bench-screw, end upwards, just put a little red colour on with a brush, then the side, matching with that end of front; get level with gauge mark on the draw front and the bottom edge. Having made a small pad of whiting (that is, break up some whiting into powder, and tying it loosely in a small bit of rag), pounce through the parts chopped out, remove the side, and a first-class impression is made of the pins. In sawing these pins, just leave the white marks on, chopping out the red parts. Glue with thin, hot glue, and set aside to dry. Next measure the depth of drawer from inside to the back. Get some drawer side stuff, cut off slips, about 1¼ wide, plane up with truth to insure a good joint; plough a groove in these the same as the front, round off the outside edge; when finished, glue with hot glue on to the inside of drawer sides, getting the grooves of the slips level with the groove in drawer front. Having put in the bottom, it now remains to be finished. In fitting in, plane with a trying-plane, starting from the front edge, shooting straight to back; set the plane fine, and take a firm stroke.

A. Best.

Erratum.—**Key Characteristics.**—In my letter on p. 267, second line following the table, the word "experienced" should have been "inexperienced."—W. Hardie.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51073.]—**Ammonia.**—The calculated sp. gr. of ammonia gas is 0·5803. Humphrey Davy found 0·5901 and Biot and Arago 0·5967. According to Miller the calculated sp. gr. is 0·5882, observed 0·69. One litre, however, at a pressure of 760 millimetres of mercury weighs, according to Biot and Arago, 0·7752gr. Its specific heat, water being taken as one, is 0·508 (Regnault). Liquefied ammonia is a colourless and mobile liquid. Its sp. gr., according to Watts, is 0·75. According to Andreef 0·6364, or according to Joly 0·6324. Its tension at – 17·78° C. = 2·48 atms.; at 0° C. = 4·44 atms.; at 10° C. = 6 atms.; at 19·44° C. = 7·60 atms.; at 28·31° C. = 10 atms. According to Miller its tension at 15·5° C. = 9 atms. It freezes into a white solid at – 75° C., and boils at from – 38·5° C. to – 37·5° C.—Lux.

[51912.]—**To Violinists who are Mathematicians.**—I beg to inform "M. W.," p. 268, that "gently plucking each string in succession" is not the proper method of tuning the violin. De Berist would have told him to draw the bow slowly and evenly across two strings at once, at the same time carefully turning the pegs until the fifths were in tune; but De Berist was an old notationist, so was Paganini, so are all the greatest violinists of the present day, and as "M. W." has discovered that defective intonation "exists in its most exaggerated form" amongst followers of this school, he will doubtless prefer his own method of tuning and playing to theirs.—T. E. D. Craven.

[51912.]—**To Violinists who are Mathematicians.**—We are approaching satisfactorily the solution of the problem we are considering. The reply of "M. W.," giving the result of his experience in the tonic-sol-fa system of music, as enabling those who have acquired a certain degree of proficiency in it, to tune with facility the violin, on their proceeding to the study of that instrument, and also testifying to the existence of difficulty in tuning it experienced ordinarily by pupils who are instructed only according to the established musical notation, justifies the insertion of the query propounded, and the consideration it has received. It is probable that the existence of this difficulty has hitherto prevented the violin from being studied, except by professional gentlemen, so much in England as otherwise it might be expected to be. Playford, in his "Introduction to the Skill of Musick," including his "Brief Introduction to the Playing on the Treble Violin" and his "Art of Descant, or Composing Musick in Parts," published in 1687, referring to the violin, recommends the beginner to tune by eighths, as easier than by fifths, and, in his quaint way, says: "To begin which, he must wind up his first or treble string as high as it will bear, and stop it in F (*i.e.*, fretted for A), then tune his second an eighth below it; then stop the second in F (fretted for D), and tune the third an eighth under it; then stop the third in F (fretted for G), and tune the fourth an eighth below that: and so," says he, "your strings will be in perfect tune." But we have yet to consider how many times per second each string vibrates when it is struck by the bow, and is in perfect tune up to a certain pitch, as the Philharmonic or Concert A. In this query will also be necessarily included what are the exact lengths of the strings, and their relative dimensions and proportions. Thus it will be seen at once that it comes as well within mathematical range as that of musical ear training.—I. F. Ballard.

[51[illegible].]—**Crystal v. Paraffin Oil.**—There is a vast deal of difference in both the colour and smell of crystal and paraffin oils. Again, in the flashing test, crystal oil is known as petroleum imported from America and other foreign parts, whilst paraffin or coal oil, as it is known by, comes mostly from Scotland and parts of England. If "Querist" will address me, I will forward him samples that he may test for himself.—W. Jones, 1, Viaduct-street, E.

[[illegible].]—**Dynamo.**—"Spark" will do well to wait until the present series of articles on the subject is finished. His armature seems rather a peculiar shape, and it is impossible to say how many lamps it will light until it is made, and its E.M.F. gauged.—[illegible]

[[illegible].]—**Defective Coil in Battery.**—To "Nun. Dor."—The instrument in question is a small medical battery; the core is ⅜in. in circumference and [illegible]in. in length. What I would like to know is the sort of wire required and the quantity, and what insulation is necessary? I have the numbers of the English Mechanic for the last [illegible] months, and if you could refer me to any particular number during that time, I shall feel much obliged.—J. D.

[[illegible].]—**Improving Draught of Chimney.**—The exhaust led into the chimney would improve the draught; but the advisability of turning it in that direction depends very much on the general conditions, which are not stated.—Essar.

[[illegible].]—**Watch Mainspringing.**—The subject was, I think, explained with tolerable completeness in Vol. XXXV. pp. [illegible], 174, and certainly in many places in back numbers "Scotia" can find the directions for putting the main spring in.—[illegible]

[[illegible].]—**Medical.**—The case is far too important for anything but expert advice to be worth anything, and no expert would say what should be done without an examination of the ear.—Bolus.

[[illegible].]—**Drilling Nickel.**—As a rule nickel dulls quite fast enough if exposed to the damp; but what the querist means I suppose is some positive means. That would no doubt be a lacquer. Acids will corrode the surface.—Nun. Dor.

[[illegible].]—**Wood Pulp.**—By heating under pressure in a boiler with the aid of caustic soda.—[illegible]

[[illegible].]—**Engine Query.**—You can easily ascertain which way the engine will run by taking note of the valve movements. Take the cover off the valve box, note when bottom and top ports open, and make marks on the rod or some other part accordingly. By noting those marks afterwards you will always be able to tell which way the engine will run.—Essar.

[[illegible].]—**Lake Strangford.**—As this query has been inserted, I suppose it is of sufficient importance; but the querist would have found the information sooner in most cyclopædias—that is, by doing a simple little sum. Lake Strangford is about 17 miles long by 4 broad. The Zuyder Zee might be measured with sufficient accuracy on any good map; but if your correspondent can turn to some of the papers presented on the drainage scheme, he would no doubt find an approximately accurate estimate of its area.—Nun. Dor.

[[illegible].]—**Electrical.**—Question is most easily answered by experiment; but as the cell described cannot have an E.M.F. greater than, say, 2 volts, it seems that it will not do the work unless the lamp has a less resistance than a potential of 2 volts can overcome. It is doubtful whether any lamp has yet been made that can be worked by one cell, no matter how large it may be.—Nun. Dor.

[[illegible].]—**Cutting Circular Glasses.**—Mount your diamond in a lever arm, and put the glass on a turntable underneath. By shifting fulcrum of arm, any size circle can be cut.—Nun. Dor.

[[illegible].]—**Lathe.**—"Miner" must excuse me if I refer him to the papers on a Cheap Lathe. I do not understand everything, only just enough to arrive at the conclusion that I know precious little.—Nun. Dor.

[[illegible].]—**Cotton Spinning.**—It is not usual to put anything on the mule bands if the latter are of good quality; but if they are inferior in this respect they are in some mills rubbed with the following mixture in order to prevent rapid wear and tear. Equal parts of blacklead and soot, mixed with a certain amount of tallow and treacle to make a suitable paste.—Silex.

[[illegible].]—**Battery.**—"Salopian" should try the Powell Battery. It is the most constant and at the same time the cheapest that I have yet met with. I have used it for lighting small incandescent lamps of one or two candle power with great success, as well as for many other purposes where a constant current is required.—Current.

[52175.]—***Perspective of an Interior.***—Very many thanks to "E. H." The diagram will, no doubt, be as useful to others as it will be to me. I am sorry to find, however, that it does not elucidate the difficulty in my picture. I wrote my query in a hurry, and without re-reading it, and, consequently, did not say what I meant to say. I did not know the right place, and put my "point of disappearance" on the north wall 5ft. from the ground, and 5ft. from the west wall (always inside). I hardly know how to describe the north ceiling, but it does not *meet* the south ceiling, but consists of a quarter of a circle, therefore it extends only 7ft. 6in. in a southerly direction from its own wall. If "E. H." would kindly help further, I should be greatly obliged. The "interior" is purely ideal, though I have painted it (incorrectly) on paper. It may be the crossbar pattern on the end of sill that is wrong alone; but I think not. "I want to know."—Murano.

[52182.]—**Inks for Bonework.**—Try the following recipes:—1. Mix well with 2oz. of diluted acetic acid, 1oz. of powdered sulphate of copper, and ½oz. of powdered sal-ammoniac. To colour it red, use vermilion; and for black, add lampblack. 2. In 10 parts of nitric acid dissolve 1 of copper, and add 10 parts of water.—W. Henley Richmond.

[52208.]—**Ink for Type Writer.**—This mixture makes a good printer's ink:—To 13oz. of rosin add 1lb. of rosin oil, and 1½oz. of soft soap. Leave the solution till cold, and then add the desired colouring matter.—W. Henley Richmond.

[52221.]—**Legal.**—The directions of the testator seem to me to be perfectly plain—viz., that when the eldest son is twenty-six the estate shall be realised; then he makes provision as to the annuities, "then to my children," &c. The whole of the directions of the will, as regard the farm, seem to hang on the presumption of the landlord's carrying it on till the eldest son is twenty-six (which, I presume, will not be for six years). As he refuses to do so, you can't compel him. You do not say whether there is any other property; I expect there is, from the proceeds by sale of which the proposed annuities are to be paid. Anyhow, you must not make the division among the children till the eldest is twenty-six.—G. Russell Pridham.

[52226.]—**Equatorial Motion.**—I fear I have not made my description of the equatorial motion to alt-azimuth stand very plain, and as "Lon" uses a Calver 10in. on this sort of stand, I will endeavour to describe plainly what I should do if my telescope were mounted in a similar manner. Referring to Mr. Calver's pamphlet on the silvered glass reflector, I see the representation of the stand, and from Mr. Calver's remarks I believe it has an iron cylindrical tube. I should, therefore, proceed in the following manner:—Presuming that the telescope is fixed in an observatory, I should draw a line on the floor due south from under the centre of the spindle on which the telescope turns. I I should then put the telescope directly over that line, and attach a string to one of the trunnions on which it rises and falls, and noting the distance this trunnion is from the centre of the telescope, should mark a line just as far from the meridian line, and on the same side of it as the string is. I should then take a common carpenter's 2ft. rule, and open it to an angle of 51°, or the latitude of the place. I should then place the rule on the last-made line and bring the string down to it, moving it backward and forward until the string was parallel to the upper side of the rule. Then I should mark the line as being opposite the place on the meridian line for the rod to support the telescope to turn on. As the telescope does not turn on the centre of the spindle, but around it, this mark would not be in the proper place; but it may be corrected hereafter, as described in my former letter. I should have previously stated that the stand must be truly upright, and the way to try that is to place the telescope horizontal by a level, and try it when over each leg of the stand, packing each up as required, until the telescope is truly level in all directions. If a spirit level is not to be had, a convenient one may be made by nailing three laths together like the capital letter A, the cross lath being placed low, and a plumb line fixed to the point at the top and hanging just below the cross lath; then placing the legs on a table or bench, mark the place where the line cuts the cross lath; turn the level round, placing each leg where the other stood. Mark again, and half-way between the two marks is the place for the line when the legs are level. The telescope being truly upright, and the mark made on the meridian line for the place of the hook, the next thing is the rod for the telescope to lean on. Place the telescope on the meridian line, so elevated as just to clear the wall of the room; then measure the distance from the bottom front of the tube to the mark for the hook on the meridian line. This will be the shortest length for the rod. Get two pieces of oak, 6in. shorter than this length, about 1½in. by 2in., planed up smooth and true. On one end of each fix a square tin ferrule, large enough for the other piece to slide through freely. Place each in the slide of the other, and there will be a compound rod capable of sliding out to nearly double its length, [illegible]in. thick when double, and 2in. by 1½in. when single. These sizes must be regulated by the weight to be carried; but this, I believe, will do for a 10in. mirror. On the end of each where the ferrule is not, screw into it a screw eye, the bottom one to turn on the hook on the meridian line on the floor; the top one for the telescope to rest on. The hook on the floor must be made of a piece of stout iron wire or rod six inches long, and one end bent to a right angle one inch from the end, which is to be driven into the floor, and the long end to lie on the meridian line just above the floor, so as for the screw eye on the bottom of the rod to slide over it and turn on it. It is made long, because we are not certain of the place for the rod to be fixed; but as the rod will stand aslant outwards, a few pieces of wood with holes in them may be put on the wire to keep the screw eye in its place, until the proper place for it is found by trials. The attachment of the upper eye to the telescope tube must be made thus—On the bottom of the front of the tube a piece of beech wood must be fixed about a foot long and four inches wide, having a deep groove cut in it for the upper screw eye to slide in, and a string being fixed to this eye, and passing through a pulley on the spindle of the stand, and thence to a gimlet in the front piece of wood, passed round the shank and made fast in a niche in the handle. The telescope may be raised or lowered by pulling the eye nearer to or letting it slip farther from the spindle of the stand. On the piece of the rod that stands on the floor must be a thumbscrew to fix the sliding piece at the proper height for the telescope to point at or near to the star to be viewed, and the correct adjustment must be made by the string and sliding eye in the groove on the end of the telescope. The weight of the telescope being on the rod, will cause it to fall from the meridian, and a string must be fixed on the mirror end of the telescope, and thence through pulleys to a lever fixed and weighted as described in the former article, because levers cannot be fixed on the spindle of the stand as in my telescope. The bladder clock must also drive the end of the telescope. Things being thus arranged, it will require a little contrivance to place the telescope on a star. It may be done thus—I will here remark that the readiest method of fixing the piece of wood on the front of the iron tubes, is to punch or drill four holes through the iron, and put through these holes common wood screws into the piece of wood on the outside of the telescope; by this means the wood is firmly fixed on the iron. Now to place the telescope at the proper elevation for a star east or west of the meridian, we require to know not only the declination of the star, but also to have some means to point out the height above the horizon to which the telescope is raised. The readiest way appears to be by the plumb line, thus: Fix a square piece of board on the side of the telescope opposite the eyepiece, and from the front corner, hang a plumb line to indicate the degree of elevation on a quadrant described on the board, and the degrees marked thereon. If, when the telescope is level, the line hangs parallel to the side of the board, and the scale begins there, the equator will be pointed at by the telescope when the line cuts the 39°, if the latitude of the place is 51°, and if to this you add the declination of the star, if north of the equator, or subtract it if south, the telescope will point to that star if on the meridian, and if the rod is truly placed, and the telescope bearing on it, the star should be found either east or west of that; at all events it will most likely be in the finder, and a turn of the gimlet to raise or lower the telescope by the sliding-screw eye on the top of the rod, will place the telescope on the star.—Philip Vallance.

[52230.]—**Legal.**—You can make over the money payable at your decease to your wife. Better consult some respectable solicitor to see the deed properly drawn and executed.—G. Russell Pridham.

[52242.]—**Deferred Agreement for a Lease.**—When A. took the farm for twelve months with an agreement with B. for a lease of seven years—I take it that the granting of the lease by B. to A. was conditional—that is, that A. should do certain things which he does not appear to have done. A. cannot now take any proceedings against B. for a lease, as (if you state the facts correctly) the agreement with B. was that at the expiration of twelve months B. should grant a lease to A. (as I suggest, not knowing the facts) on condition of A. doing certain acts. If A. did not do those acts, he cannot compel B. to grant him the lease.—G. Russell Pridham.

[52249.]—**Chromograph.**—"J. S. M." will find the following a good 'graph composition—viz., Water, 2 parts (by weight), glue 2 parts, glycerine, 4 parts, a few drops of carbolic acid, and sufficient powdered whiting to give the whole a milky appearance. Leave the glue to swell in the water for five or six hours, melt, and add the glycerine, carbolic acid, and whiting, stirring whilst doing so. When the ingredients are thoroughly mixed, pour into the tray or other receptacle prepared for it, and leave it to set. Wash the surface well before using. For melting purposes a large earthenware jam jar slung in a pot of boiling water will be found to answer well, but the jar must not touch the bottom of the pot. This composition is easily made, cheap, and will give a great number of copies, and the ink can be quickly washed off with a sponge and warm water. As to the method of preparing ink and "sheets" I cannot speak, never having tried to make them myself.—W. C.

[52256.]—**Brush Dynamo.**—To "Light" and W.H.E., Coventry.—If the E.M.F. of my machine is too low, what result should I get by rewinding it with fine wire on "A"? At present 26 yards of wire on each coil. Suppose I try No. 18, giving 47 yards to a lb., instead of a present No. 16, 26 yards to a lb. I have increased the speed from 1,500 to 2,000 revols., and get slightly better results in my arc light, but very far short of what it should be. Here is where I want to succeed, not being particular about incandescent lamps. At what speed would it be advisable to run A. at, to be safe when at work? So far as the construction is concerned, I have no fear up to 4,000, having run it this speed. The E.M.F. is so low that it will not draw the A. of lamp into coil, the weight being supported on springs. A reply will be esteemed.—Williams.

[52257.]—**Medical—Intermittent Pulse.**—If "D" would take 5 globules of titim in drink at breakfast, 5 globules of betonica in drink at dinner, 5 globules of thymus in drink at supper, he would find himself better very soon. Titimalus lathyris.—The properties of the milk thistle. The use of these globules bring back the normal state of the intestinal functions. Thymus vulgaris.—Common thyme is an aromatic stimulant; it is used in atony of the digestive organs. Flatulency.—From Dr. Count Manzetti, Manual, page 40.—Etheropathy.

[52259.]—**Sizes of Tinplates.**—The usual sizes of tinplates are 14in. by 10in., 15in. by 11in., and 16¾in. by 12½in. The term "common" is applied to thin plates, a box of which containing 225 plates weighs 1cwt. Every "cross" signifies an addition to the thickness of the plate. Tin plates are made of various qualities, "ternes" being the commonest and "charcoal" the best, "coke" being an intermediate quality. The cooking utensils sold by the best makers are made of charcoal tin of two or three cross thickness. Tin plates are made in the neighbourhood of Wolverhampton. There are also some makers in South Wales.—Thos. Lisle.

[52259.]—**Sizes of Tinplates.**—The usual sizes are 14 by 20 and 14 by 10, and are put up in boxes of 112 of the former and 225 of the latter size, which weigh 1cwt. The terms "commons," "crosses," "cokes," and "charcoal" signify the description; the plates being sold on the basis of 1 C, which represents one common and weighs 1cwt. of 14 by 20 112 plates, and of 14 by 10 225 plates. A cross signifies additional weight, and each cross represents a price of 6s. per box extra. Thus, if a box of 1 C costs 16s., 1 × will cost 22s., × × will cost 28s., and so on. The terms "coke" and "charcoal" represent the kind of iron of which the plates are composed. The best tinplates are procured in the neighbourhood of Kidderminster; but the largest number of works are around Swansea. I will gladly furnish "F. C. F." with any particulars if he sends his address. I may add that I am not a dealer in them, or in any way an interested party, but a regular shipper thereof to Australia, where a large quantity are sent annually.—J. G.

[52259.]—**Sizes of Tinplates.**—Tinplates are properly thin sheets of iron coated with tin, and are called after the quality of iron from which they are made—as coke tinplates, the commonest charcoal, best charcoal, and soft steel, the latter having the past few years superseded charcoal. A coke tinplate is not so well tinned as a charcoal tinplate, and, being of a harder nature, will not stand working like a charcoal: it is used for case lining, making canisters, common teapots, kettles, &c.; but for deep stamping and where much strain is required, a charcoal or steel tinplate is used. They are made principally in South Wales, and a few comparatively in Staffordshire, the principal sizes, &c., are as follows, applying alike to charcoal and coke quality:—

		Sheets. to box.	cwt.	q.	lb.	B.W.G.
1 C.	14 × 20	112	1	0	0	30
1 x.	,,	,,	1	1	0	28
1 x x.	,,	,,	1	1	21	26 easy
1 x x x.	,,	,,	1	2	14	25
1 x x x x.	,,	,,	1	3	7	25 full
D C.	17 × 12½	100	0	3	14	28 full
D x.	,,	,,	1	0	14	25 easy
D x x.	,,	,,	1	1	7	24

Further information if desired.—Henry J. Sayer.

[52260.]—**Tinware Manufacturing.**—The fact of "F. C. F., Artisan," requiring information on this subject shows that it would be imprudent for him to commence business in this line. The plant for manufacturing the articles he enumerates would cost several thousands of pounds. A list of the tools required would *occupy too* much of your valuable space; but it would include a steam engine, a large lathe, several stamps, presses, and many tons of dies. The competition in this class of goods is so keen that a thorough knowledge of the business, and a large capital, is absolutely necessary to make a profit. As a proof of this, I may say that patty pans are sold wholesale at three halfpence per dozen, this being as near as possible the value of the raw material. Your correspondent may guess how a profit is made.—Thos. Lisle.

[52268.]—**Will.**—I see no reason why Mary Jones should not take the £400 in full satisfaction, if it is mutually agreed upon; but it would be scarcely legal, because the testator (or testatrix, you don't mention which), seems to stipulate that she is to be paid "20s. weekly," &c. Of course, if she took the £400 there would be an end of the matter: she would have no further claim. I am not certain about the latter part of your query, but will look it up and try and answer you next week.—G. Russell Pridham.

[52271.]—**Lever Watch.**—1st. Perhaps in certain positions the 'scape-wheel touches the lever, or else the belly of the pallets. 2nd. Though the balance jewels are not broken or worn, they may be loose, as they sometimes are, and therefore should be fixed by making the end-stones press tightly against them. 3rd. If neither of these reasons be the real cause, I can only suppose the defect is in the motion work. Perhaps the motion wheel gets partly off its stud, and so gets wedged in its action. When the hairspring is tightly pinned in, the action of the watch is not so liable to fall off as otherwise.—A Watchmaker.

[52271.]—**Lever Watch.**—In the hundreds of watches that I have had to examine, I never found one escapement left in the conditions stated by "J. G."—i.e., escape wheel teeth foul of the "belly" of pallet; neither did I hear of the idea of shifting jewel holes to free such. I should say most likely the following are at fault—i.e., when in a hanging position the balance falls nearer to the lever, and the roller comes foul of the guard pin; and probably the ruby pin strikes the horns of lever in entering the notch, if the staff has a lot of side shake, would cause this fault. Examine the fit of staff, and see that the pivots are long enough to come through jewel holes, and very little side shake. If the pivot holes have this fault, you must either have new jewel holes fitted to the staff or turn in a new staff, which is not a difficult job for a practical man to do—about two hours' work—and no man ought to be trusted to repair watches that cannot turn in a staff. Also see that you have not bent the guard pin in cleaning. Try shake of lever at each banking, and see that there is equal run to each—just enough to see daylight through roller edge and guard pin, and that balance is free of everything; also hairspring.—G. Sumner.

[52272.]—**Superheater.**—By far the best plan would be to pass steam through separate fire. If "A. G. H." will send me his address, I will advise him as to best course.—F. M. Rogers, 21, Finsbury-pavement.

[52275.]—**Notary Public.**—A n.p. need not now be necessarily a lawyer, therefore need not serve articles with a lawyer. I believe the examination is the same as that through which an accountant has to pass to enable him to become chartered—that is a member of the Society of Accountants.—G. Russell Pridham.

[52275.]—**Notary Public.**—There are two methods by which a person may obtain a notarial faculty. First by what may be termed the orthodox way—that is, by service for five years as articled clerk to a notary, who, at the expiration of that period, must file an affidavit of proper and due service. The applicant must then produce to the Faculty Office the original articles, together with a certificate from two notaries testifying "to his skill and probity." These notaries are expected to examine the candidate; but the work is somewhat formal. Certain oaths are then administered to the candidate—namely, the oath of allegiance, the oath of supremacy, and the oath of due service. If the candidate intends to practise in London, he must then become a member of the Company of Scriveners. These formalities having been duly complied with, a notarial faculty is issued from the Court of Canterbury by the Archbishop. The total cost, exclusive of any premium, is about £50; and a practising certificate, costing £6, is needed every year. The second, or unorthodox method of becoming a notary, is to be admitted under the provisions of 3 and 4 William, c. 70, under which Act solicitors or proctors are admitted to practise as notaries, in certain districts only, on a petition being sent to the Faculty Office showing that there does not exist in the district a sufficient number of notaries. If this point be established to the satisfaction of the Court, which will also hear any opposition from notaries already in the district, the applicant receives a limited faculty, granting him notarial powers in the district mentioned only. I do not know the cost of this proceeding. This Act only admits persons who are already on the Law List, so I suppose it will not be of much service to the querist. The office of notary is of very great antiquity, having existed in the reign of Edward the Confessor. Notaries are under the jurisdiction of the Master of the Faculties. If "Banker" desires any further information, he may communicate with me privately.—Wm. John Grey, Notary Public, Newcastle-on-Tyne.

[52279.]—**N.E.R. Engines.**—If Mr. M'Donnell has not turned out any new engines, he has altered the general appearance of some of the old ones to a considerable extent by fitting them with turned-out funnels, new doors on the smokebox, &c., besides painting them a brown colour, which makes them hardly as "showy" as the old Gateshead engines used to be.—W. Thompson.

[52280.]—**L. and N.W. Engines.**—66 Experiment (Jan. 1882), 300 Compound (March, '83), 301 Economist (March, '83), 302 Velocipede (April, '83), 303 Hydra (April, '83), 305 Trentham (July, '83), 307 Victor (July, '83), 519 Shooting Star (July, '83), and 520 Express (July, '83) are the L. and N.W. compounds. They are stationed at Crewe, and (with the exception of Experiment) are fitted with the vacuum brake. Full dimensions have been given in back numbers. The engine in the Watford accident was not a compound, but "482 Pegasus," one of Mr. Webb's "Precedent's" stationed at Rugby).—J. E. Spencer.

[52281.]—**Boiling Frosted and Chased Silver Articles to Whiten Them.**—Boil in a strong solution of cyanide of potassium. Be careful with it—being a deadly poison; afterwards wash with soap and warm water, and dry in fine boxwood sawdust.—Henry J. Sayer.

[52283.]—**Surveying Instruments.**—Get Heather's "Mathematical Instruments," by Crosby Lockwood and Co., 4s. 6d.—C. R. T.

[52284.]—**Telescopic Field of View.**—Mr. Webb in "Celestial Objects" says nothing about focus, aperture, &c.; but simply to note accurately the time taken by a star or planet on or near the celestial equator in passing centrally across the field of view. This, in minutes and seconds of time, multiplied by 15 will give in minutes and seconds of arc the result required by "E. M. R."—Arthur Mee.

[52284.]—**Telescopic Field of View.**—Mr. Webb in "Celestial Objects" says nothing about focal length, &c., in this connection; simply to note the exact time in minutes and seconds taken by a star as near as possible to the celestial equator in passing centrally across the field of view. This quantity multiplied by 15 gives diameter of field in minutes and seconds of arc. If "E. M. R." and other querists would procure the absolutely invaluable treatise referred to above, much space now devoted to astronomical inquiries might be saved. Arthur Mee.

[52286.]—**Observatory Instruments.**—"E. M. R." will find what he wants, I think, in Mr. Lockyer's valuable book, "Stargazing, Past and Present"; in Dunkin's "Astronomy," one of Lardner's series; and in "Chambers' Descriptive Astronomy."—C. R. T.

[52289.]—**How to Leave my Property.**—I should advise this querist to see a solicitor, as his affairs appear to be too complicated for a reliable reply to be given here.—G. Russell Pridham.

[52289.]—**How to Leave my Property.**—Is not this question rather "too too"? Surely, it is the duty of every good citizen to pay any tax legally levied, and not seek to evade it. If the tax is unjust, by all means get up an agitation and seek its abolition; but while it is the law, I think it is scarcely honest to seek to evade it. I make these remarks because I see it stated that a certain very rich nobleman (save the mark!) has evaded a payment to the State (that is, the nation) which, according to the law, would have been due if the law had not been evaded.—Nun. Dor.

[52294.]—**Legal.**—B. having become security to the bank for £50, can be compelled by the bank to pay. B. has his remedy against A. if he is compelled to pay. If B. at the time had not got his bankruptcy annulled, and the bank were cognisant of the fact, they acted most improperly in accepting him as security; but if they were not told this, then the money was obtained by fraud, for which they could prosecute A., as, no doubt, he was aware of the fact; which, however, they would first have to prove.—G. Russell Pridham.

[52296.]—**Nearest Fixed Star.**—Alpha Centauri is stated to be the nearest, and its distance over 200,000 times that of our sun. The estimate in *Girl's Own Paper* is obviously a slip—it may be a printer's muddle. "Stellarius" is surely somewhat severe on the conductors of an excellent journal which does not pretend to be scientific.—Arthur Mee.

[52296.]—**Nearest Fixed Stars.**—If "Stel rius" will refer to page 480 of "Chambers's D scriptive Astronomy," he will find a table [illegible] stars with their parallax, &c., which may interest him, a few of which, with the Editor's permission, I give below:—

Star.	Parallax.	Distance.	Time of Light Reaching the Earth.	Observer.
		Miles	m. s	
Sun	[illegible]	[illegible]	[illegible]	
		Sun = 1.	Yrs.	
[illegible]	[illegible]	[illegible]	[illegible]	Maclear
[illegible]	[illegible]	[illegible]	[illegible]	Auwers
[illegible]	[illegible]	[illegible]	[illegible]	O. Struve
[illegible]	[illegible]	[illegible]	[illegible]	Von Gylden
[illegible]	[illegible]	[illegible]	[illegible]	Brunnow
[illegible]	[illegible]	[illegible]	[illegible]	C. A. F. Peters
[illegible]	[illegible]	[illegible]	[illegible]	C. A. F. Peters

—[illegible]

[illegible]—**Bunsen Battery.**—Will "Electrician," who replied to this on p. [illegible], kindly tell me the size and number of the chromate cells required to [illegible] of platinum wire, No. 26 B.W.G. [illegible], and the relative proportions of the inner and outer cells that they may become connected together, and the relative areas of the two elements to produce the best results. Also the best plan of keeping the battery in good order when it is only occasionally used, as it would not be required for more than half an hour at a time. What are the red and white salts of the Fuller battery composed of? "Electrician" says "the same position of the elements are retained as in 'Bunsen,'" and then says "the bichro. solution is to be placed in [illegible] vessels, and the dilute sulphuric acid in the inner one." Now, as in all Bunsen cells that I have seen the carbon is in the inner, and the zinc in the outer, does he mean that the bichro. solution is to be put with the zinc, and the sulphuric acid with the carbon? Or is it a misprint?—[illegible]

[illegible]—**Bunsen Battery—Altering Form.**—If the fumes are the only objection, why not place the battery out of doors? To alter the form, take out the nitric and sulphuric acid, wash cells and buy some gas-retort carbon, which is sold at [illegible], and coarsely-granulated oxide of manganese, [illegible]. Break carbon into small pieces about [illegible] and with an equal part of the oxide of manganese fill up the porous cell to within [illegible] of the top, after placing in the carbon block; then cut a piece of cardboard to fit the top of the porous cell, with a hole to allow slipping over carbon block and a hole at side about ¼in. diameter [illegible]. Now remove clamp from top of carbon block and wind round a piece of copper wire twice, twisting tightly with pliers, leaving about a foot attached. [illegible] pitch [illegible] porous cell, and, with a [illegible] brush [illegible] carbon block, [illegible] porous cell [illegible] all round. It is now finished, and may be set aside to harden. [illegible] bottom and [illegible] a piece of copper wire [illegible] brush with hot pitch [illegible] inside and outside. When this is dry place with porous cell in jar, which three-parts fill with water; add [illegible]. Let it stand an hour or two, and you will have a capital constant battery. [illegible] without giving the slightest trouble.—Harry [illegible].

[illegible]—**Ice and Skating.**—My opinion is that the safest way is to break the ice at the edges, and to allow [illegible] the water. It is not so [illegible] if it were secured tightly to the [illegible].—W. [illegible].

[illegible]—**Ice and Skating.**—If my memory is correct this question was discussed in "[illegible]" a considerable time ago. I think that the ice will be [illegible] when water [illegible] rather than when [illegible] to the [illegible].—[illegible], Newcastle-on-Tyne.

[illegible]—**Methylated Spirit.**—Absolute alcohol may be obtained [illegible] with caustic lime or [illegible]. The distillate [illegible] either [illegible] water [illegible] from the air.—William [illegible].

[illegible]—**Methylated Spirit.**—The water in methylated spirit may be partially removed by treating it with carbonate of potash in the following manner: Place a pint of the spirit in a good stoppered bottle with about a couple of ounces of well dried carbonate of potash; the mixture is to be shaken occasionally for two or three days, and then allowed to stand; the carbonate is insoluble in the spirit, but having a great affinity for water, abstracts most of it, forming a dense layer at the bottom, from which the spirit can be decanted. The spirit thus obtained has a small proportion of water, which may be entirely removed by digesting it in a closed glass flask or retort, with about half its weight of fresh quicklime in coarse powder, for two or three days, and then gently distilling by immersing the flask or retort in a water bath, so as not to exceed a temperature of 200° F. The first ounce or so of the distillate should be rejected, as it contains the moisture of the apparatus. The absolute alcohol thus prepared requires to be carefully stored in well stoppered vessels, as it readily absorbs water from the atmosphere. Possibly the first part of the process would suit the requirements of "Solvo."—W. E. Haden.

[52301.]—**Locomotive Engine Cylinders.**—Inside cylinders, with valves between them, should not be made larger than 17in. to 17½in. diameter. Much larger cylinders are actually in use—18in., 18¼in., &c.; but I object to them very much, as the crank webs are dangerously thin, the bearings very short, and the valves are so crowded that the exhaust is throttled. If valves are placed either above or below, cylinders of even 22in. can be used without difficulty. I hope to see 20in. cylinders soon in use for express work, as I have no doubt that large cylinders in an ordinary engine will give better results than compounding. The "Gladstone," on the L.B. and S.C., is doing quite as good work on even less coal than the compounds on the N.W. The Midland is building 19in. cylinder engines for its Scotch traffic.—Historian, M.I.M.E.

[52302.]—**The Cheapest Food.**—There is a small book, price 6d., called "How to Live on Sixpence a Day," which, perhaps, might contain some of the information you require. I do not know who the publisher is; but a short time ago it was offered for sale at most of the stations on the Metropolitan and District railways.—Machina.

[52302.]—**The Cheapest Food.**—Dr. Nichol's "Food of Health," and "The American Breakfast Cereals" might meet the wants of "S. R." I have used both, and find that, if carefully prepared, they are most nutritious, wholesome, and cheap. Eaten with milk these foods are delicious, and quite capable in themselves of supporting the system.—Arthur Mee.

[52302.]—**The Cheapest Food.**—The cheapest foods I know of at the present time are haricot beans, boiled or baked with cuttings of fat bacon and flavoured with herbs, &c.; oatmeal and skim milk prepared in the way described by Dr. Edmunds. The latter is admirably suited to growing lads and children; the former may form the midday or principal meal of the hardworking labourer. Vegetables are, as a rule, very dear (as food) in towns; but the great aim should be to vary the diet as much as possible, though oatmeal and skim-milk (porridge) would form a better standing dish than the present bread-and-butter. Much depends on the nature of the work done by the eater, and it is nonsense to talk of the beef-eating habits of the Anglo-Saxons being the cause of the immense number of diseases. The poorer classes here get too little beef, while the Esquimaux live almost entirely on animal food, and don't want many doctors.—Common Sense.

[52303.]—**Faulty Ports.**—I think your ports are too small. I had one cylinder 3¼in. by 2½in. bore. It would just drive my 4½in. lathe, taking a light cut, at 50lb. per sq. inch. I got a stronger boiler and tried it at 100lb., and it was not much stronger, owing to the small ports and exhaust. If you cannot have any more pressure on your boiler, fix a smaller pulley on engine shaft, and run the engine from 100 to 200 revolutions per minute.—W. W. W.

[52304.]—**Legal.**—Without your permission the man has no right whatever in your timber yard: he is, in fact, a trespasser. He can, however, advertise over his gable end if he chooses, and you can't stop him. If you build on your yard and the bills are posted on his property so as to be an annoyance to you, no doubt you then could come to some arrangement in the matter; but you certainly could not make him take them down.—G. Russell Pridham.

[52306.]—**Volt Meter.**—To "Sigma."—A volt meter is merely a galvanometer wound with a great length of fine wire, which may be of German silver to give resistance. In Ayrton and Perry's, which is inquired for, the magnetic field and direction power is obtained by placing the galvanometer coils between the poles of a powerful permanent magnet. I cannot undertake to give the details of construction, which would require drawings, for which I have no time. But all that is necessary is a small coil with a sharp point outside it, mounted between the poles, the needle working on the outside of the coil. The graduation can be effected by means of several Daniell cells put into circuit one after the other, so as to mark the deflection each addition makes, which is a little over one volt of E.M.F. For large currents the matter is more difficult, as the resistance must be a little over one thousandth of an ohm. The best way is to make one with stout wire, and graduate it by comparison, or by a Daniell cell and resistances, and then shunt it off to the required amount. But it would be cheaper to buy than to make.—Sigma.

[52312.]—**L. and N.W. Locos.**—136 (Crewe) and 1107 (Birmingham) are Mr. Webb's 4ft. 7½in. 8-wheeled 4-coupled wing tanks; cylinders, 17in. by 20in. 303 Hydra, one of Mr. Webb's compounds. 373 Snake (Shrewsbury) is one of Mr. Trevithick's 6ft. 6in. outside-cylinder single-wheel engines; cylinders, 15in. by 20in. 395 Scotia (Crewe), 1489 Brindley (Peterborough), and 2006 Princess (Shrewsbury) are Mr. Ramsbottom's 6ft. 6in. 4-coupled express engines: cylinders, 17in. by 24in. 463 (Stafford), 569 (Birmingham), and 1506 (Longsight) are Ramsbottom's 5ft. 2in. 6-coupled goods engines; cylinders, 17in. by 24in. 675 Ivanhoe (Longsight) is one of Ramsbottom's 7ft. 6in. outside-cylinder singles of the "Lady of the Lake" class; cylinders, 16in. by 24in. 829 Turk (Nuneaton) is one of Mr. Ramsbottom's 6ft. 4-coupled passenger engines; cylinders, 16in. by 20in. 1009 (Birmingham) and 1015 (Birmingham) are Mr. Webb's 4ft. 3in. 6-coupled wing tanks; cylinders, 17in. by 24in. 1364 (Longsight) is one of Mr. Ramsbottom's 4ft. 4-coupled saddle tanks of the 1437 class. 2401 (Chester) is one of Mr. Webb's 4ft. 3in. coal engines; cylinders, 17in. by 24in.—J. E. Spencer.

[52313.]—**Trigonometry.**—This query is one of a class seldom suitable for these reply columns. 1st. Add together equations 1 and 2.

$$a \sin.^2 \theta + a^1 \cos.^2 \theta + b \sin.^2 \phi - b^1 \cos.^2 \phi = a^1 + b.$$

Or—

$$a \sin.^2 \theta - a^1 (1 - \cos.^2 \theta) - b (1 - \sin.^2 \phi) + b^1 \cos.^2 \phi = o.$$

Or—

$$(a - a^1) \sin.^2 \theta - (b - b^1) \cos.^2 \phi = o;$$

$$\text{that is, } \frac{\sin^2 \theta}{\cos.^2 \phi} = \frac{b - b^1}{a - a^1}, \text{ put this} = m.$$

The third equation (divided by 3) is equivalent to—

$$\text{Sin.}^2 \theta - \sin.^2 \phi = \frac{b^1}{b}, \text{ put this} = n.$$

In these two equations for brevity, let $x = \sin. \theta$ $y = \sin. \phi$; then we have—

$$x^2 = m (1 - y^2)$$
$$x^2 = n + y^2.$$

From which—

$$y^2 (m + 1) = m - n.$$

Or— $$y = \sqrt{\frac{m - n}{m + 1}}$$

And from this—

$$x = \sqrt{\frac{m (n + 1)}{m + 1}}.$$

By substituting the previous values of m and n, we shall get the answer in terms of a, b, a^1, b^1.—Orderic Vital.

[52319.]—**Telescope.**—"J. P. R. A." does not give the amount of his highest magnifying power; if, however, as he says, it defines badly, there does not seem much hope of 120 doing better, and, indeed, his 1¾in. o.g. must be good to bear this on planets. With so small an aperture one can hardly advise a stop, yet "J. P. R. A." might try the effect of aperture reduced to an inch; also his astro. eyepieces with the field lenses (those nearest o.g.) removed. What does he mean by the "shadow" of Jupiter's belts?—Arthur Mee.

[52321.]—**Faulty Sewing Machine.**—One, or a combination of the following causes will account for the machine missing a stitch:—Needle not set right height; needle being broken at point, or not set right way about. Shuttle being worn generally on the face, or having caught against the needle sometimes and blunted the *nose* of shuttle, or needle and shuttle are a little out of time with each other. Examine and report further, and I will tell you how to remedy, if you find any of the above defects.—J. I. S.

[52323.]—**G.W. Engines.**—821 (806—825) are 6ft. 6in. single framed 4-coupled passenger engines, were built at Swindon in 1873 (May to September); 931 (927—946) are 5ft. double framed 6-coupled goods engines built at Swindon in 1874; 1036 (1016—1075) are double framed 6-coupled saddle tanks, built at Wolverhampton from 1867 to 1871; 1142 (1134—1153) are 5ft. 6-coupled double framed saddle tanks, built at Swindon in 1874 and 1875; cylinders, 17 by 24; 1808 (1801—1812) is a 4ft. 6in. 6-coupled saddle tank, cylinders, 17 by 24; 2201 is a 6ft. 6in. 4-coupled single framed passenger engine: cylinders, 17 by 24.—J. E. Spencer.

[52327.]—**Gong.**—Simply a piece of round steel wire bent in the form of a watch spring, fastened another for nothing. I do not like them in use, and always prefer a common blacklead pot for hard work. They are valuable for hurried experiments, but the glaze gets exceedingly sticky at high temperatures, and the crucibles rapidly foul. If "R. W. F." knows any crucible material which has not some serious objections, I should like to be informed about it.—Thos. Fletcher, Warrington.

[52360.]—**Integrals.**—(1) Multiply numerator and denominator by $x - \sqrt{(x^2 - 1)}$. We have

$$\frac{dx}{x + \sqrt{(x^2 - 1)}} = [x - \sqrt{(x^2 - 1)}]\,dx = x\,dx - \sqrt{(x^2 - 1)}\,dx$$

Integrating

$$\int\frac{dx}{x + \sqrt{(x^2 - 1}} = \frac{x^2}{2} - \int\sqrt{x^2 - 1}\,.\,dx$$

Integrate the last term by parts,

$$\int\sqrt{(x^2 - 1)}\,dx = x\sqrt{(x^2 - 1)} - \int\frac{x^2\,dx}{\sqrt{(x^2 - 1)}}$$

but

$$\frac{x^2}{\sqrt{x^2 - 1}} = \frac{x^2 - 1}{\sqrt{(x^2 - 1)}} = \frac{\sqrt{(x^2 - 1)}}{1}$$

$$= \sqrt{(x^2 - 1)} + \frac{1}{\sqrt{(x^2 - 1)}}$$

Therefore

$$\int\sqrt{(x^2 - 1)}\,dx = x\sqrt{(x^2 - 1)} - \int\sqrt{(x^2 - 1)}\,dx - \log.\,[x + \sqrt{(x^2 - 1)}]$$

or

$$2\int\sqrt{(x^2 - 1)}\,dx = x\sqrt{(x^2 - 1)} - \log.\,[x + \sqrt{(x^2 - 1)}],$$

and

$$\int\frac{dx}{x + \sqrt{(x^2 - 1)}} = \frac{x^2}{2} - \frac{x\sqrt{(x^2 - 1)}}{2} + \frac{1}{2}\log.\,[x + \sqrt{(x^2 - 1)}].$$

(2.)

$$\sqrt{(2ax - x^2)} = \sqrt{[a^2 - (a - x)^2]},$$

Put $a - x = z$. Then $-dx = dz$.

$$\int\sqrt{(2ax - x^2)}\,dx = -\int\sqrt{(a^2 - z^2)}\,dz$$

$$= -z\sqrt{z(a^2 - z^2)} - \int\frac{z^2\,dz}{\sqrt{(a^2 - z^2)}}$$

$$= -z\sqrt{(a^2 - z^2)} - \int\frac{a^2\,dz}{\sqrt{(a^2 - z^2)}} + \int\sqrt{(a^2 - z^2)}\,dz$$

$$= -\frac{\sqrt{z(a^2 - z^2)}}{2} - \frac{a^2}{2}\sin.^{-1}\frac{z}{a}$$

Now, the limits $x = 2a$ or o, give $z = -a$ and $+a$, therefore,

$$\int_o^{2a}\sqrt{(2ax - x^2)}\,dx = \frac{\pi a^2}{2}$$

—Nabla.

[52366.]—**Skates.**—Skates made with a toe and heel plate are very good, but I do not recommend having a fanciful curve on the toe part of the steel. Many accidents have arisen from them. A skate made with a steel, same pattern as the Acme, has the plates you mention, looks nice, and is very useful. You can have a curve to any shape you fancy, but avoid a long shape curve, especially a pointed one.—T. P.

[52367.]—**H.P. of Engine.**—"Ignoramus" does not say whether he requires the nominal or the indicated horse-power of his engine. I have supposed he requires the latter, as the term "nominal horse-power" is now seldom used except for commercial purposes. An engine with a cylinder 28in. diameter, stroke 6ft. 3in., pressure of steam 40lb. per square inch, and making 24 revolutions per minute, should develop 223 indicated horse-power. The rule for working this out is as follows:

$$\text{Indicated H.P.} = \frac{2\,A\,P\,R\,S}{33000}$$

or—

$$\text{Indicated H.P.} = \frac{2\,A\,P\,r\,S}{550}$$

A = Area of piston in square inches.
P = Average pressure of steam in pounds per square inch in cylinder.
S = Length of stroke in feet.
R = Number of revolutions per minute.
r = Number of revolutions per second.

—T. R. Saxton.

[52368.]—**Red and Blue Photographs.**—I am afraid I can tell you nothing about red photographs; but you can take blue prints from a negative in the following manner. Immerse a piece of paper (ordinary writing paper will do) in a solution of ammonio-citrate of iron, and allow it to dry in the dark. Use this to print your positive copy from the negative, in the same way as you would the sensitised albumenised paper. Print it until a faint image appears; this usually takes about ten minutes or a quarter of an hour in the sun, or about an hour in the shade; be careful not to overprint it—a faint image is all you require to see. Then take it out of the frame, and in a darkened room immerse it in a solution of ferro-cyanide of potassium; then well wash in cold water; then immerse it in a solution of bichromate of potash, which will cause it to turn to a fine blue; after this well wash it and let it soak for a few minutes. The picture is then finished.—Machina.

[52373.]—**Polishing Brass.**—This is easily done with a little machinery; but I should think the cheapest and simplest plan would be a large and heavy grindstone, of, say, 8in. across, covered with several folds of tightly-drawn felt, and driven by a powerful foot treadle, the plates to pass between uprights adjusted to guide them, and to be pressed down on the felt and fed along by ths hands, being prevented from buckling by a temporary backing of strong board, which even if the plates were very thin would admit the polishing of all but the extreme ends, which could then be completed by being separately held on the stone for a moment. For curved plates this would, of course, require modification. The pumice stone in a powdered condition, or other polishing medium, might be applied by a pepper castor or flour dredger as often as necessary. Edward Conry.

[52379.]—**Banjo.**—I should say that oiling the vellum would spoil it. Keep it as tight as you can, so that the feet of the bridge hardly dent it. Always put the bridge down after playing, as, if left up, it will in time make two little "pits," which will not go away. On a damp day the vellum is always slack; but judicious warming at a fire has a very good effect. The strings should be the following (seven-stringed):—1st, tuned to D, an E violin; 2nd, tuned to B, an E, slightly thicker; 3rd, tuned to G, an A violin; 4th, tuned to D, octave below 1st, and 5th, tuned to C, one tone below 4th, a D violin, a *thin* American wire-covered string; 6th, tuned to G, octave below 3rd, a thicker wire-covered string; 7th, or "thumb" string, tuned to G, octave above the 3rd, an E violin, thin. For a six-stringed 'jo, the 5th string is done away with; for a five-stringed, the 4th and 6th; at least, this is my arrangement; but different players have different customs. I always use a seven-stringed instrument.—An Amateur Banjoist.

[52379.]—**Banjo.**—If it is the banjo pure and simple that "A Lunitick" wishes to play, the less he alters the quality of its tone the better; but if he would like in its place some nondescript instrument, he may, by either employing a thicker vellum, or by putting a slip of pine from rim to rim under the bridge, or even by substituting a wooden for a skin soundboard, modify the tone to any quality he pleases; though he would find that, as the tone improved (?) it would lose the rollicking "tum, tum" so characteristic of the banjo. Banjos as usually sold are rather gingerbread affairs, or I would recommend a covered fifth string and thicker gut throughout. It might, however, be well worth while to divide the finger-board into a scale of semitones, guitar fashion. This may be done by placing pieces of ivory or hard wood veneer just where the half-tones come, allowing for pressure by the finger, and testing by a correctly-tuned piano or harmonium. These pieces can be let into saw-kerfs and fastened with glue. For rapid execution they will be of the greatest service, as they not only make it impossible to stop out of tune, hut give a clearer ring to the stopped notes to afford greater facility to the fingering. I am afraid our old friends, "Fiddler" and Mr. Schucht, will think I also am somewhat of "a lunatick" when I say that the banjo deserves next rank to the piano for domestic music. The pity is that it has been so associated with nigger melodies that directly it is heard one naturally expects a clatter from the bones, or some outlandish conundrum that would be quite out of place in a drawing room. —W. H. Davies.

[52379.]—**Banjo.**—You may appropriate the following ideas, patented by Temlett, A.D. 1869, viz., improvements in banjos and certain other stringed instruments. In banjos the hoop (on which the vellum is stretched) is inclosed "in an outer casing or sound-box," and the back is made with double sides formed by the inner and outer hoop or casing. The inner hoop is, by preference, made of less depth than usual, so as to extend but a short distance within the outer box or casing. The perch of the neck, instead of passing through the inner hoop, is carried below it, and passes through the sides of the outer casing, to which it is secured in any suitable manner. The tailpiece is connected to the end of the perch as usual; the means of attachment, however, pass down between the inner hoop and casing, and serve to keep the latter securely in position. The tension of the vellum is regulated by screws taking into brackets on the inner hoep, and worked from the front by a key. Also another patent, A.D. 1867—viz., to render the instrument portable. The neck or finger-board is made in two lengths, united with a hinge. When played upon, the joint is kept extended by a hook, otherwise the player can pass an elastic band over the strings above the joint, and another just below the pegs, unfasten the hook, and fold over the top part of the neck on the front part of the tambour, &c. Don't oil the vellum, which should be dry and warm; and you might try very thin steel wire for some of the strings. Now, if you lay the banjo on a table, face up, it will sound better, proving that it wants more body, and to do this means a larger sounding surface, which we have in a guitar and violin. You can add a larger surface by adding a box, or a curved form of wood, to your banjo; it would have to be quite 8in. deep, including the present hoop. This would be awkward to hold, while 4in. would do very well to hold. Yet this might be got over by having two hoops or banjo bodies joined together at their sides, as a figure ∞ with the middle of the figure cut out, forming an indented oval. This would be a guitar without a back, and altogether too long; so there is no remedy, seeing that the banjo is only an initial instrument. Gut strings covered with silk are most in use, requiring constant tuning. I should try a deeper body, if I were you.—Fiddler.

[52386.]—**German Lacquered Mouldings.**—These appear to me to be covered with tinfoil. Try a coat of glue (hot and clear, and not thick) brushed over the plain moulding, and then lay on a sheet or strip of new pure tinfoil, and wipe with a rag or stipple with a soft brush into all the pattern. It would have to be done quickly. When it was quite set, say the next day, it would require to be washed very quickly and dried by heat, and lacquered whilst perfectly dry and hot, and in a hot room. I think you would not be able to make your own lacquer to your own satisfaction. It would be better to buy "gold lacquer for tin."—Murano.

[52387.]—**Absorbent Cotton Wool.**—This is made, I believe, by immersing ordinary cotton in a hot solution of weak caustic alkali, and afterwards thoroughly washing in a stream of water and drying. I have used large quantities, but never made any; the information is, therefore, only second-hand.—Thos. Fletcher.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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51805. Vivaria, 96.
51816. Watch-Dial Painting, 96.
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51844. Transmitter, 97.
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52106. Jacquard Loom, 184.
52110. Mangle Rollers, 184.
52115. Bramah's Press, 184.

A New Otto Tricycle.—At a complimentary dinner given to Mr. F. S. Hunwicke, last Tuesday, at the First Avenue Hotel, to commemorate his remarkable ride from London to Edinburgh, 402¼ miles, in 4d. 15h. 5m., a new Otto tricycle was shown in model form. This machine is a centre driving front steerer, with several features of novelty and usefulness. The wheels, for instance, are much narrower than usual, and have a series of spokes in the plane of the rim, with the outside and inside spokes acting as stays. By this means remarkable strength, with great lightness, is obtained. The steering is effected by means of the usual bar with gearing through the tube supporting the front wheel, and is so arranged that the rider's body is naturally inclined in the same direction as the machine turns. The band brake is very powerful, and is applied by means of one of two studs on the steering bar worked by the thumbs, one being sufficient to apply the full power, while a handle behind the head applies the brake until it is released. The saddle and driving gear are mounted on a swinging frame, so that the rider takes automatically the best position for exerting his strength. The machine is mounted from behind, and can be left at a moment's notice. The Otto tricycle will undoubtedly attract much attention when it is introduced next season.

QUERIES.

[52388.]—**Warp Winding.**—Will some reader explain the drawing of a heart for a warp-winding machine ? or what lines are used to draw a heart right ? as I see they are not all the same.—An Apprentice.

[52389.]—**Sulphuric Acid.**—Will some kind friend show me where I have gone wrong in my method of finding the specific gravity of a mixture of sulphuric acid and water ? Let me take a mixture containing 76 per cent. of acid of specific gravity 1842, what is the specific gravity of the mixture ?—1842 × ·76 = 1399·92, say 1400 ; this added to 1000 × ·24, the quantity of water in the solution, gives 1640 as the specific gravity of the mixture ; whereas in Thorpe's "Quantitative Analysis" I find the specific gravity for this percentage is 1686.—Chemical.

[52390.]—**Dynamo.**——I have built a dynamo somewhat after the style of the Lumley machine, with pole-pieces top and bottom, and wire wound on each side in four sections ; F.M.'s are wound with No. 14 B.W.G. double c.c. wire, 9½lb., each layer varnished with shellac. The armature is built of two rings of iron wire with three crossbars equidistant from each other in the form of a drum, and the wire wound on longitudinally outside and inside of the ring. The A. is wound with 30 sections of 8ft. each No. 18 B.W.G., the inner end one coil and the outer end of the next connected together. When charged by two bichromate cells, I get a very slight deflection of the needle. When connected so as to charge itself, I get none at all. Speed 1,000 revs. per min. I have tested the A. and F.M. for insulation, and there is no defect. Can any of our kind readers tell me where I am wrong ? Inside pole pieces 4in. ; diameter of armature 3⅜in.—Faulty Dynamo.

[52391.]—**The "Kewanee" Windmill.** — Can any of "ours" kindly inform me where I can find a fully illustrated description of the "Kewanee" American windmill, made at 35, Broadway, New York—patented December 23rd, 1873 ? as I have come into the possession of one (or rather the parts), and I wish to put it into working order. The wheel is 11ft. diam.—E. R. Dale, Godmanstone, Dorchester.

[52392.]—**Gavitation.**—Would one of your correspondents kindly solve the following ?—In Newth's "Mechanics" occurs the problem :—"A ball is projected vertically upwards at velocity of 120ft. per second. At what height will it be at the end of four seconds ?" The solution is given as follows : 120 × 4 = 480, this less the space due to gravity in four seconds ($16·1 \times 4^2$ 257·6) gives 122·4 as the answer. So far good ; but in the same book the rule given for finding how long a body projected vertically upwards will ascend is to divide velocity by 32·2 and $\frac{120}{32·2} = 3·72$, so that the body would be ascending for only 3·72 seconds altogether. Now, further, for finding how high it will ascend Newth gives the rule—16·1 × time in seconds square and $(3·72)^2 \times 16·1 = 215·74$ft. In the short interval between this and the end of the fourth second the ball could not have descended to 122·4ft., as Newth gives it. How reconcile the two workings ?—Beginner.

[52393.]—**Water Consumption of an Engine.**—Can any of my brother-workmen give me any information ? How can I get the water consumption of an engine from the actual diagrams, as the same must vary from different points of cut-off ; that is, how much water should I have to evaporate to supply an engine with steam ? Please give the water-rate in pounds. The engine is a high-pressure engine. Initial pressure 73lb. ; absolute initial pressure 28·5lb. ; average pressure upon piston 39·75lb. ; area of cylinder 388·8 ; piston speed 450ft. ; dry steam per i.h.p. 23·74 ; scale 40lb. to the inch ; i.h.p. 210·6 ; steam at opening of exhaust 11·5lb.—J. N.

[52394.]—**Electrical.**—Will any of your electrical correspondents inform me if a zinc element would last longer (when in contact with caustic soda or potash) if gilt, than when amalgamated with mercury ? I do not object to the cost of gilding the zinc if it would render the element durable ; but the caustic potash acts rapidly on amalgamated zinc. Would our kind and obliging correspondent, "Sigma," kindly reply ? I have been experimenting lately with oxide of copper batteries, and hope soon to lay the results of my experiments before the readers of "ours."—Scrutator.

[52395.]—**Dynamo.**—I think of constructing one to be driven by a ½-horse engine ; but before doing so I should like to know what parts I must not touch when it is running. Can I touch the bearings to see if they are getting hot without fear of receiving a shock ? Suppose I supply four lamps, and I shut three lamps off when the machine is running, will it spoil the other lamp ? or what would it spoil if I shut all four lamps off when running ?—W. W. W.

[52396.]—**Legal.**—To Mr. Wetherfield.—A. sells to B. a quantity of coal under land which B. rents of A. as tenant from year to year. In three or four years B. purchases the land and house also from A. On the death of B. the whole passes to C., the eldest son and heir-at-law of B. C., at his death, gives the house and land by will to D., but nothing is said about the coal, or any appurtenances thereto belonging. At C.'s death D. claims the coal as legatee, and E. claims it also as only brother and heir-at-law of C. Which of the two has a right to it ?—J. S. Saddler.

[52397.]—**Raising Water.**—Wanted a definite rule as to how many feet in height 1lb. pressure of steam will raise water in a pump, whose diameter is half of that of the steam cylinder ?—A., Coventry.

[52398.]—**Astronomical.**—What will be the latitude and longitude of the earth's surface where the sun will appear vertical at 12 o'clock on the 21st of December at noon, and 12 o'clock on the night following ?—L. H. S.

[52399.]—**Governors.**—Would some of our mechanical friends kindly give me a formula that would enable me to get the speed per minute of the governors patented by C. T. Porter (makers, Omerod, Greison and Co., Manchester) ? and formula for the Buss's governor would oblige.—A. S. Hood.

[52400.]—**Reading Lamps.**—I have a gas reading-lamp with a black indiarubber tube. The latter emits an unpleasant smell of gas and indiarubber combined. Is it possible to cure this ? Would enamelling or varnishing the tube effect the purpose ?—G. C. G.

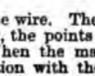
[52401.]—**Pianoforte Tuning.**—To Mr. Davies.—Mr. Davies, in answering a query on the above on p. 191, No. 918, refers the correspondent to p. 571, No. 830. On turning this up, I find he there states to tune C to the fork ; then G a fourth below ; then tune the remaining fourths and fifths in a similar manner. Their order is as follows : G to D. D to A, &c. Am I to understand him to mean to tune G to D up, then G to D down ; D to A up, and D to A down, and so on with the others ? or what ? (2) And also in answer on p. 571, No. 830, he says the G below C is one beat flat ; and then on p. 191, No. 918, it is given that each ascending fifth is to be one beat flat. How is this ?—A. D.

[52402.]—**Pulley.**—Will any of our practical readers tell me how to set the pulley so as to drive a machine set at right angles from the line shaft, what is termed a half-cross belt, and how to set carrier pulleys ?—J. W. S. B.

[52403.]—**Repairing Dies.**—Part of my occupation is repairing dies for screwing bolts. They are solid dies, and are made from double shear steel, which I cannot temper satisfactorily ; for in the hardening of them they fly in the pillars, and if I give them a lower heat they are soft. Can any brother advise me on this point ? Also, which is the best steel for that purpose ?—Alpha.

[52404.]—**Strains.**—A span is placed on board a ship, between the fore and main masts, and a weight of, say, 10 tons is suspended on the centre of span for lifting. How can I find strain on each end of span, and is the strain altered by the angle of span ?—R. J. P.

[52405.]—**French Polishing.**—Will the author of "Carpentry Hints," or any other of our valued correspondents, kindly give me instructions ? I have made several articles—brackets with spindles, &c.—in pine and birch, which I want to be black and polished. I have tried the effect on a piece of wood of painting in black and varnishing ; but it does not suit. It gives the wood a common appearance, and not the nice smooth effect of polish with which the Early English styles of furniture are finished. Any information will be thankfully received.—J. Watkinson.

[52406.]—**Cylinder Electrical Machine.**—To Mr. Lancaster and Others.—I have made the machine as follows : Cylinder consists of a glass gas jar 8in. long and 4½in. wide, and open at the bottom : to which I have cemented a circular disc of wood fitted with a wooden axle, and I have gummed three strips of tinfoil 3in. long by 1½in. on the cylinder. The rubber is a piece of leather stuffed with horsehair and tacked on a thin lath of wood. As to the prime conductor, I cut a piece of wood about 4in. long off a broomhandle and covered it with two thicknesses of tinfoil ; one end I fixed a brass ball in connection with the foil, and the other a piece of brass wire in the shape of a  with eight brass points which I soldered on the wire. The whole is supported on a piece of glass tubing, the points being about ¼in. from the glass cylinder. When the machine is set in motion (the rubber in connection with the earth by means of a length of brass chain) I get no spark from it ; but on presenting my knuckles to the brass ball, I felt a sharp pricking, but observed no spark. How is this ? Have I constructed it right ? I should be much obliged for information on the matter.—A. N. A.

[52407.]—**Oxy-Hydrogen Lantern.**—As I am using the oxy-hydrogen lantern weekly in public, and am somewhat inexperienced in the use of the mixed gases, I shall be glad to know if danger is to be apprehended from any other cause than unequal pressure on the bags, and also whether equality of pressure must be exactly preserved—say to an ounce or a pound ? Will the use of double-pressure boards entirely remove the possibility of accidental explosion ? Does pure hydrogen help to produce a better light than when the carburetted is used ?—W. Hobbs.

[52408.]—**Skin Disease.** — A poor hardworking mechanic has had for some time a kind of eruption on his left leg, on the knee, and on the calf, which has somewhat the appearance of ringworm. It appears at first like a portion of a small red ring, between the size of a threepenny-bit, and a shilling. It yields to tincture of iodine, but again appears somewhere else, or perhaps in the same place. He says it is at times rather itchy. Can it be ringworm ? Does ringworm appear anywhere except on the head ? Would Dr. Edmunds kindly suggest a remedy ? Is it infectious or contagious ?—Mechanic.

[52409.]—**Legal.**—A. dies and leaves some of his property to B., at whose death the said property to go to her eldest son C. The son dies before his mother, but leaves two sons. Does the property at the death of B. go back to the estate, or will C.'s children take it, or the next son of B. ? Can B. will it to whom she likes ?—Brighton.

[52410.]—**Dynamo Machines.**—Can any of your readers tell me what relation the thickness of the wire on the armature of a dynamo-electric machine bears to the electromotive force and to the quantity of the current produced ? Is the relation constant or variable, and does it depend on the weight of wire or on its surface ?—A. G.

[52411.]—**Cheap Lathe.**—With reference to the last article on this subject : As there are many amateurs who, like myself, have not access to such a large lathe as would be required to bore out the headstocks in the way described, would the writer or some other competent subscriber say if there is not some other way of boring the heads, and explain how ?—Amateur.

[52412.]—**Painting Lantern Slides.**—Can any correspondent inform me how to mix or make colours for lantern slides that will dab deeply and evenly, and at the same time dry well ? I can get very good daylight effects with the ordinary artists' colours, but cannot get deep colours—as for moonlight. Moreover, they do not dry well, even with baking. I should also like to know if there is any mechanical means of taking out a moon so as to be sure of getting it round and clear.—E. W.

[52413.]—**G.N.R.**—Does Mr. Stirling continue to build 8ft. singles ? What are principal dimensions of latest class of four-coupled express ?—J. E. Spencer.

[52414.]—**G.W.R.**—Can any reader oblige me with the number and dimensions, &c., of (1) the 6-c. named and numbered B G. goods ? (2) 4-c. B.G. (3) 4-c. N.G. side tanks without condensing pipes. (4) A new class of 6-c. N.G. tender goods without dome (No. 2301, &c.). (5) 6-c. N.G. side tanks, without dome (No. 1815, &c.). With reference to railway speed, I think the G.W.R. holds a good place. On the 22nd ult. the B.G. train due at Paddington at 8.10 p.m. passed Hanwell at 7.50, or about 11 min. before time. As this train is due to leave Swindon at 6.42 p.m., it gives a speed of 61·764 (70 miles in 68 min.).—T. M. R.

[52415.]—**Rushton's Self-Acting Fountain.**—To "Glatton."—I want to make a fountain as described by you in letter 51577 ; but it seems to me that if the water is poured into C, it will fill C and then rise up the pipes E and F, and nearly fill B before it ceases to leave the basin A. Also, will not the pressure of air on the top of B and C prevent the water from flowing down the pipe D after it has passed through the jet ? If "Glatton" will set me right, I shall be greatly obliged.—Student.

[52416.]—**Holding Links without String.**—Would any reader assist me with any instructions as to how I may fasten three links on a drawbar while I repair the broken end ? For instance, I fasten the first link with a wedge through the hole in hook, and then fit a pair of tongues on the end of the link, and then put the end link on the hook, and tie the middle link to the tongues, which takes up a deal of time, and you need have a great many different sizes of tongues to fit every link, as they vary so, and I have a great many to repair. They run about 6ft. long, and are not very light to lift about, and you cannot turn them about on the anvil without you have them fast, and on a line with the drawbar. A sketch would enlighten me. I want it to be as light as I can, and a remedy that will do away with the string, and not take long. I don't want to cut them out.—Midland Subscriber.

[52417.]—**Siemens' Dynamo.**—I want to make a small armature (drum-shape) for the above dynamo. Kindly give size of wire, winding, &c., and oblige.—Constructor.

[52418.]—**Photographing in Natural Colours.**—A few years ago I asked in "ours" if this had ever been done. By a curious coincidence someone about the same time read a paper somewhere on the subject. Has this ever come to anything ? Hand-coloured photos are at best daubs : reminding one of the hand-coloured illustrated books children used to have.—Murano.

[52419.]—**Memorial to Home Secretary.**—Must this be presented by a deputatation, or can it be sent by post ? How should it commence ? Any particulars will will oblige.—M.

[52420.]—**White Fillings for the Teeth.**—On p. 216 I saw an account of "dentists' white fillings," and I procured the oxide of zinc and pyrophosphoric acid, but I cannot get it to set, and I have tried all proportions. Can anyone help me with a little knowledge ?—J. Morgan.

[52421.]—**Partnership.**—To Mr. Wetherfield or Others.—A. is a partner in two firms, A. B. and Co. and A. C. and Co. A. B. and Co. fail ; but before this the partnership of A. C. and Co. is dissolved to prevent any complication, and A. is paid out. A. receives his discharge from his private creditors, but in the liquidation by arrangement of the firm's affairs, the creditors turn and refuse discharge. Is it safe for A. to go back to A. C. and Co. if he can borrow sufficient capital, some two years having elapsed since his trouble ?—O.

[52422.]—**Legal.**—I took a house on a yearly tenancy, and paid the outgoing tenant for venetian blinds, curtain poles, &c., and gas fittings, for which he gave me a receipt. Can I legally take them away when I give up possession of the house ?—Tom.

[52423.]—**Paint for Machine Tools.**—Will some kind reader inform me how to obtain a hard, smooth, and durable surface ?—G. B.

[52424.]—**Red Casting Wax.**—Could any reader kindly give me a recipe for red wax ? It will have to be rather brittle. I want it for the purpose of casting stove grate panels.—Modeller.

[52425.]—**Gaiffe's Peroxide of Manganese and Chloride of Zinc Battery.**—Will "Sigma," or other correspondent, kindly give an opinion upon the beforementioned battery ? Outer cell contains zinc rod with a 20 per cent. solution of chloride of zinc. No inner cell, but the carbon is in shape of a cylinder in which holes are bored longitudinally and filled with granulated peroxide of manganese. It is claimed for this element—(1) No creeping up of salts, the oxide of zinc formed not adhering to the zinc rod, but falls to the bottom in a pulverulent state. (2) The affinity of the chloride for water considerably diminishes the amount of evaporation—Chloride of Zinc.

[52426.]—**Voss Electrical Machine.**—I should be much obliged if any reader would tell me me how to fasten the revolving plate of a Voss machine to the axle. We use a 15in. plate of common window-glass, with a 1in. hole in the centre. This we clamp between two brass plates 3in. diameter, padded with indiarubber ; but we find that the plates very soon begin to crack, the cracks spreading from the centre to the outside of the plates, and rendering them useless. Some seem to advise that the plate should be fastened with marine glue. If this is used, is it necessary to have any hole in the plate ? Does not the glue get soft when the machine is warmed, and so allow the plate to slip out of its proper position ?—C. W. A.

[52427.]—**Adhesive and Waterproof Paste.**—Will some of our chemists kindly try to help me ? I want a transparent, adhesive, and waterproof paste tissue paper which has to pass over a cloth satu with the paste (cold) on to a spindle, on which spirally coiled. There is a German recipe comp [illegible] and ammonia, full particulars and [illegible] will greatly oblige.—P. E. M.

[illegible]—**Battery.**—I am making a small medical coil, and want a [illegible] small battery to work it. Chloride of silver [illegible] generally used. Can any one tell [illegible] a small form? I want to be able [illegible] portable.—T. P.

[illegible]—**Electrical.**—Will some one inform me what amount of water will be decomposed into oxygen and hydrogen per indicated horse-power per hour from a dynamo of [illegible] efficiency? Wether a dynamo producing [illegible] of high or low tension would be most suitable. Whether ozone can be produced by electricity generated from a dynamo, and if so, how?—INQUIRER.

[illegible]—**Chemical.**—Will some chemist inform me whether it is possible to make chlorate of barium (used in pyrotechny) from fluoride of barium and chlorate of potash? It is desired to utilise some fluoride of barium, which is at present a by-product.—MANUFACTURER.

[illegible]—**Iron Railway Sleepers.**—Some years ago the Barlow iron sleepers were largely used. Can any readers state if any now exist?—as a party of engineers, including myself, desire to visit any part of the country to see them in actual use.—HISTORIAN, M.I.M.E.

[illegible]—**Railway Time Signals.**—Wanted, details of a railway time signal used some years ago at [illegible] to inform drivers how long the previous train had left. Are any of these still to be seen at work?—HISTORIAN, M.I.M.E.

[illegible]—**Midland Engines.**—Wanted some details of [illegible] 124, 132, 142, 145, and 149, and where they are stationed.—HISTORIAN, M.I.M.E.

[illegible]—**Gout.**—Would some medical reader kindly give me his opinion of *Physalis alkekengi*, which I have been recommended to take for gout? It is, I believe, the active principle in certain pills. Is there anything objectionable in its continued use, and does it injure the system in any way, as colchicum does? I have inherited, and not acquired, the gout, and have never had a fit of it. Mine is generally "misplaced or retrocedent."—FAL.

[illegible]—**Extraordinary Phenomenon.**—What is this light that makes so grand an appearance some time after sunset and before sunrise now? Every day that the sky is clear this week I have seen it. The most interesting part to me is that I have always seen it in the day whenever the sky is clear, extending about 18° from the sun, causing the blue sky to appear of a beautiful mauve tint. This would seem to dispense with the idea of its being "sunset glow," as indeed would also the fact of the phenomenon being seen in India and at the Cape. Are we to suppose that there is a mass of [illegible] matter now lying between us and the sun? and has there been any record of such appearances as are here seen having previously occurred? The sight is altogether new to me. I trust we shall get further accounts from clearer climes.—HERBERT INGALL.

[illegible]—**Lachnanthes.**—Any particulars respecting the above drug (said to be an unfailing specific for phthisis) would no doubt be interesting to many of "ours."—H. [illegible]

[illegible]—**Paper Ornaments and Toys.**—I want to cast a quantity of paper ornaments and toys like those we get from Germany, but I cannot get the castings [illegible] from mould, and in drying they shrink too much. Will any one kindly describe the process?—X. C. L. R.

[illegible]—**Ventilation of Rooms.**—In issue of [illegible] there is a reply by "Initials" to some question on this subject. He says, "Tredgold's rule is, multiply the number of people in room by four, divide the product by forty times the square root of the height of the tubes in feet. The quotient is the area of the ventilating tube in feet." It is quite evident the sum [illegible], the height of the tubes having [illegible] their capacity of admitting air. Their [illegible] number of square inches in [illegible] for fresh air, is surely what is wanted. Has any reader access to "Tredgold's Rule," or can anyone give a working rule for capacity of inlets to proper ventilation of living rooms?—R. W. J.

[illegible]—**Transparencies.**—Can any of "ours" [illegible] how to take off the film of an ordinary gelatine negative either in the case of a developed negative or a positive by contact, without injury to the picture? My object is to transfer the film on to a piece of porcelain ware, or as the case might be, on to opal glass plates. A line or two from some of our friends would be greatly esteemed, and would no doubt be a source of interest for others situated as myself. I am sure if [illegible] films can be successfully transferred, many pleasing decorations and pictures can be made. I might [illegible] that I have tried the formula of 1oz. [illegible] to the pint of water, but I find this does not [illegible] and seems to dissolve the gelatine, [illegible]

[illegible]—**Water Power.**—On a piece of land in my [illegible] is a very strong spring of water; it rises [illegible] 2ft. I wish to use that water for a [illegible] I propose to make an embankment, and run the [illegible] wheel or obtain power by any other means. [illegible] the best means for obtaining that [illegible] the reservoir would fill to the [illegible] the level of the field; therefore, I [illegible] fall. If the power was not sufficient to [illegible] constantly, it is desirable to run a [illegible] the reservoir empty, stop the [illegible] allow the reservoir to fill up again.—[illegible]

[illegible]—**Paper Bricks.**—Could any of ours kindly [illegible] by 7in. square, something of the [illegible] tough and leathery, some composition [illegible] into a mould, that would [illegible] affected by water.—N. B.

[illegible]—**Complementary Colours in the** [illegible]—[illegible] kindly explain why [illegible] when the polariser [illegible] are complementary to those in [illegible] parallel? I may say that I [illegible] produced, but cannot [illegible] why they are complementary, though I have [illegible] Tyndall and Ganot.—NICOL.

[52443.]—**Overworked Brain.**—I suffer from blood to the head when I read much, or have more than ordinary worry or work, with an increasing loss of memory. I am 52. I take a rest every summer, and often go to a hydropathic establishment, and a few years ago was abroad travelling for six months. I do not sleep well, and suffer from flatulent distention. I overtaxed my brain some years back, and have never quite recovered from the strain. Can any reader kindly suggest any simple remedies which do not entail absolute suspension of work or prolonged absence from home? I have been much interested in what has appeared lately in these columns on the subject of nervousness.—B. M.

[52444.]—**Electric Current.**—Will "Sigma" or Mr. Lancaster kindly inform me if an electric alternative current of high power could be obtained from eight coils of wire placed on the polar ends of eight steel permanent horseshoe magnets weighing over ½cwt., the armature being of iron in windmill form, rapidly passing the magnet ends. This principle of fixed coils is made use of in Wheatstone's A B C magnetic transmitters, but have soft iron cores (fastened to the steel) on which the wire is wound. I desire to know if same effects can be had by winding direct upon the magnets, as in the telephone?—ROMULUS.

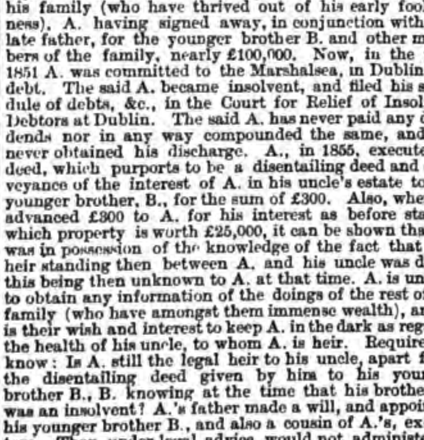
[52445.]—**Legal.**—A. is the next heir by entail to property of an uncle, now 80 years of age; but owing, unfortunately, to his not having a friend in the whole world, and hardly the means to exist, is unable to get right advice. A. is also estranged from every member of his family (who have thrived out of his early foolishness). A. having signed away, in conjunction with his late father, for the younger brother B. and other members of the family, nearly £100,000. Now, in the year 1851 A. was committed to the Marshalsea, in Dublin, for debt. The said A. became insolvent, and filed his schedule of debts, &c., in the Court for Relief of Insolvent Debtors at Dublin. The said A. has never paid any dividends nor in any way compounded the same, and has never obtained his discharge. A., in 1855, executed a deed, which purports to be a disentailing deed and conveyance of the interest of A. in his uncle's estate to his younger brother, B., for the sum of £300. Also, when B. advanced £300 to A. for his interest as before stated, which property is worth £25,000, it can be shown that B. was in possession of the knowledge of the fact that the heir standing then between A. and his uncle was dead, this being then unknown to A. at that time. A. is unable to obtain any information of the doings of the rest of his family (who have amongst them immense wealth), and it is their wish and interest to keep A. in the dark as regards the health of his uncle, to whom A. is heir. Required to know: Is A. still the legal heir to his uncle, apart from the disentailing deed given by him to his younger brother B., B. knowing at the time that his brother A. was an insolvent? A.'s father made a will, and appointed his younger brother B., and also a cousin of A.'s, executors. They, under legal advice, would not administer to the will, as the legacies made by A.'s father were much in excess of the value of his personalty. There is a quantity of jewellery, &c. A. does not know what they have done with it, and A. being the eldest son, is he not entitled to some portion of it, if not the whole? Also, would it be possible to obtain legal and other assistance, and how? A SUBSCRIBER FROM THE 1ST VOL.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXIV.—By D. MACKAY.

Black.



White. [5+6

White to play and mate in three moves.

SOLUTION TO 859.

White.	*Black.*
1. Kt-K B 3	1. K takes R (*a*)
2. Q-Q 4 (ch)	2. P takes Q
3. Kt mates	
	(*a*) 1. P-Q B 7 (*b*)
2. B-K 2	2. Anything
3. Mates	
	(*b*) 1. Q B moves (*c*)
2. R-Q 4 (ch) &c.	
	(*c*) 1. Kt moves
2. Q K B 4 (ch)	2. Anything
3. Kt mates	

SOLUTION TO 862.

White.	*Black.*
1. K-Kt 3	1. Q-Q Kt 3
2. Q-K 3	2. P takes Q
3. Kt mates	

If 1. $\frac{\qquad}{\text{Q-Q Kt 6 (ch)}}$ 2. B takes Q, &c. 1. $\frac{\qquad}{\text{Q takes B}}$ 2. Q-K sq (ch); 1. $\frac{\qquad}{\text{K-Q 6}}$ 2. Q takes Q P (ch) &c.

This problem has other solutions, overlooked by the author, beginning 1. Q-Kt 2 (ch) and Q takes P (ch).

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 860 by J. B. of Boxford (very good), R. A. Bennett and S. Seymour Follwell (a very pretty problem: several plausible attempts; and pieces all bear well on their work).—This problem should have been numbered 861. To 862 by J. B. of Boxford, Schmucke, and Dicky Sam (all second solutions).

GAME received with thanks from J. Jowett.

MISS F. F. BEECHEY's and T. B. Rowland's work, "Chess Fruits" (a sequel to "Chess Blossoms"), will shortly be published. It will contain 100 problems, poems, and humorous sketches. The price to subscribers is 2s. 6d. The Editor's address is 10, Prince of Wales-terrace, Merrion-road, Dublin.

Mr. J. P. TAYLOR's entertaining work, "Dot's Diary," to which we drew attention some months ago, has been kindly offered by the author to the solver who scores the most marks in the two-move problems published between January and June, 1884. We may mention that this book contains an admirable illustration by Faed, and that it has met with most favourable notices in the *Saturday Review* and other leading papers. There are still some copies left, which may be obtained of the author 63, Malvern-road, Dalston. The price is 2s. 8d.

WE also offer a copy of Baxter's "Chess Problems" to the highest scorer in the solution of the three-movers during the same interval.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 894, 897.
Bookbinding: Nos. 613, 627, 770.
Cements: Nos. 377, 729.
Coils, induction: Nos. 620, 640, 779, 797, 832, 885
Coils, medical: Nos. 844, 898.
Copying processes: Nos. 750, 753, 761, 762.
Electric bells: Nos. 545, 558, 797.
Electric machines: Nos. 368, 380, 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Electro-plating: No. 833.
Lacquers: Nos. 429, 475, 622, 866.
Magneto-electric machine: Nos. 376, 589, 783, 826.
Nickel-plating: No. 808, 811.
Silver-plating: Nos. 830, 868, 869, 870, 871, 874.
Telephones: Nos. 692, 695, 747, 781, 809, 828, 846, 853, 865, 894.
Varnishes: 321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 5, and unacknowledged elsewhere:—

GEO. HOPE.—W. Coleman.—J. Drage.—R. Gibbens.—E. White.—E. M. Nelson.—W. P. K.—H. T. Vivian.—Miserkerr.—W. T.—Meteor.—Marcos Snodland.—Wm. Hosken.—Amateur.—A. B. C.—Gossan.—Sabata.—M. Sykes.—Anxious.—W. Thompson.—H. D.—F. Grant.—Ratio.—C. E. Stretton.

A. Y. Z. (From the "University Calendar." See pp. 439, 488, Vol. XXX. Mr. H. K. Lewis, of 136, Gower-street, W.C., we believe, issues useful guides to the examinations.)—BEVEL EDGE. (There are several in back volumes. See p. 8, Vol. XXX.; p. 524, Vol. XXXVII. We do not know the one you mention.)—SUFFERER. (See p. 370, last volume, or p. 448, Vol. XXIX.)—BOREAS. (You will find several in the publishers' catalogues. See that of Crosby Lockwood and Co. We think that certain textbooks are recommended in the syllabus.)—A YOUNG CLERK. (It is impossible to answer such questions, as everything depends on the capacity of the learner. You should try for a similar post in this country before venturing to America.)—

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 14, 1883.

ELECTRIC RAILWAYS AND TELPHERAGE.

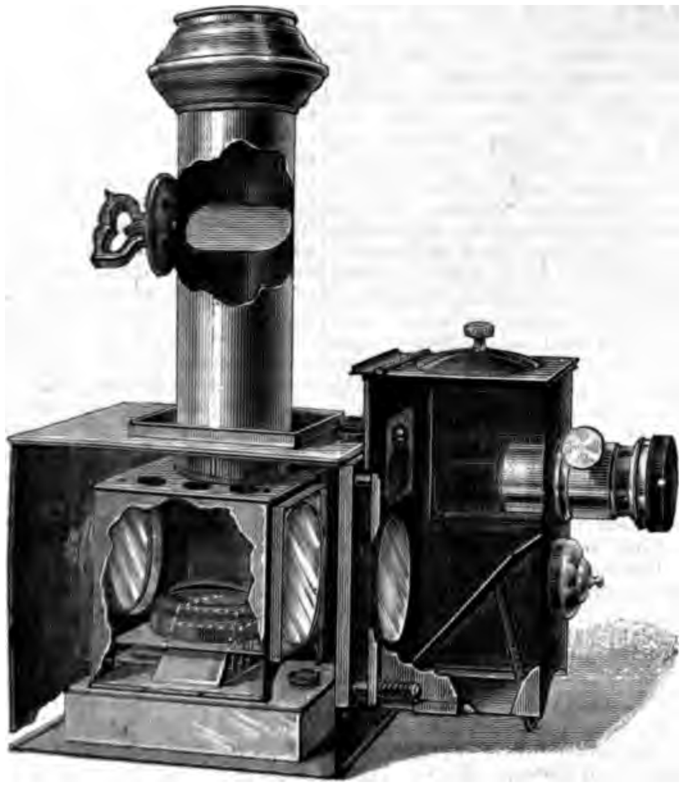
WE promised a few weeks ago to give an account of Prof. Fleeming Jenkin's system of electrical railways, which he has named Telpherage—a simple corruption of "telephorage," with the object of making a better-sounding word while retaining sufficient of the meaning to clearly indicate the nature of the new means of rapid conveyance. We have already given tolerably full accounts of the different electrical railways which have been inaugurated mainly by the brothers Siemens, and, as we mentioned at the time, Prof. Fleeming Jenkin commenced the present session of his class at Edinburgh with a lecture on "Telpherage," which is destined to play an important part in the inland carrying trade of the future. It will be in the recollection of our readers that Profs. Ayrton and Perry exhibited a large working model of their electric railway at the Royal Institution in the beginning of 1882, and Prof. Fleeming Jenkin, who had already put his ideas into definite shape, sought their co-operation. The result was that the three gentlemen named, although taking out separate patents, have combined their interests, and hold equal shares in the Telpherage Company, Limited, which is carrying out a series of practical experiments on the estate of the chairman, Mr. M. R. Pryor, of Weston, near Hitchin. For tolerably obvious reasons these experiments are confined mainly to discovering the best means of working a sort of light rope railway by electricity, which would convey parcels and light goods generally at a high rate of speed. On p. 233 of our last volume, we gave an account of some ideas put forward by an enthusiast, who thinks it possible the passenger trains may be propelled at the rate of a hundred miles an hour by means of electricity; and lately we notice that, electric light companies being at a rather low ebb, electric railways are receiving patronage which they could very well dispense with. Prof. Jenkin's idea is to transport passengers as well as goods; but he, and those who are acting with him, are well aware that in matters of this kind it is advisable to move slowly and make sure of every step, if any lasting results are to be attained. For this reason the experiments at Weston are being carried out on a working scale, with the view of perfecting the system by a natural process of evolution, before introducing it to public notice. In the simplest arrangement of the system patented by Prof. Fleeming Jenkin, there is a break of continuity at each post supporting the cable, the sections being insulated from each other and the earth; they are, however, capable of being connected by movable coupling pieces, actuated by the train, so that all the sections receive the exciting current and form part of the general circuit. Current is supplied to the cable by a stationary dynamo, and in circuit with the cable is an electric locomotive, which is provided with a governor to check the speed if it should become excessive. The line being elevated on insulating posts, leakage is reduced to a minimum, and like most lines of the kind which have not a separate insulated conductor the sections are short—so that a train always spans at least one of the junctions. The sections are connected by bridge-pieces automatically thrown over by the advancing end of the train, and put into the circuit again by the rear end. The *coupling pieces may be* replaced by an automatic telegraph, which is also used to insure that one train shall not overtake another. It is unnecessary to describe the exact mechanical details adopted; but the principle will be readily understood, and it will be seen that the current can pass in series through any number of trains on the line; but the more there are, the greater will be the demand made on the generating dynamo. In the experimental line at Weston, the supporting posts are 60ft. apart, and carry two lines of rods on crossheads fitted with cast-iron saddles so shaped as to facilitate the passage of the cars; there is thus an up and a down line. Square and round steel rods and steel ropes are all in use; but at present it seems likely that the round rod will be adopted as the standard rail of the Telpherage system. The line is divided into electrical sections of 120ft., insulated from one another, and the train is the same length as a section. The alternate sections are insulated from the ground, and are in electrical connection with each other, as are all the uninsulated sections. The insulated sections are supplied with electricity from a stationary dynamo, and the current passing from them to the uninsulated sections through the motor drives the engine or locomotive. A wire connects one pole of the motor with the leading wheel of the train, and the other pole is connected by similar means to the last wheel, the other wheels being all insulated from each other. Thus a train, wherever it stands, bridges a gap between an insulated and an uninsulated section. The train consists of seven buckets or skips, each weighing with its load 3cwt., and a locomotive which also weighs about 3cwt.—the gross load being 24cwt., and the paying load 17cwt. The skips and the locomotive hang below the line, and resemble in some of the details the devices adopted on wire tramways as they are termed. The skips hang from one or two V-grooved wheels; but the engine is supported by two broad flat wheels, and is driven by a couple of horizontal gripping wheels, the connection between these and the motor being made by the new design of friction gear which Prof. Jenkins calls nest gear. The skips are evenly spaced, and coupled by ash bars and iron pins. The locomotive is capable of exerting as much as 1½ horse-power, and the grip is almost frictionless, the gear running silently and easily; but other motors made on the plan devised by Profs. Ayrton and Perry give 1½ horse-power, with a weight of less than 100lb. Thus far a general description of the line and its stock as it exists: it is very short, and can show only one train each way; but it has already demonstrated the fact that a cheap and readily constructed line of electrical "permanent way" can be erected which will convey a paying load of 15 cwt. on each alternate span of 120ft., or 16½ tons per mile, which, at five miles an hour for 20 hours, gives 1,850 tons per day. It will be seen that there is nothing about 100 miles an hour in that estimate, and as a matter of fact, the arrangements are not suited for high speeds; but sufficient has been done to show that Telpherage will be a valuable means of conveying all kinds of goods, produce, manufactures, and minerals from outlying districts to factories or towns, or to existing railway stations for despatch in the usual way. In new colonies, as Prof. Jenkin points out, the Telpher lines will often be cheaper to make than roads, and will transfer goods more cheaply; in short, the Telpher line will do whatever the wire tramway does, and more besides. The steel rods used for the existing line are 1in. in diameter; but a smaller type, with a line only ⅝in. in diameter, is in course of construction, having smaller spans, which will probably be extended for a mile or so. At present the company does not contemplate working any lines extending more than five miles from a station; but one station could, of course, work any convenient number of lines radiating in all directions. Where it is necessary to go beyond five miles, an engine station would be needed at about every ten miles. The company is not yet in a position to fit up Telpher lines, because many details, such as sidings for loading and marshalling trains, have yet to be devised and tested, as have the arrangements for governing and blocking; but the directing spirits of the enterprise are convinced of the feasibility of their plans, and in a short time will submit them for public patronage.

The arrangements we have described are obviously unfitted for high speeds, because, to mention only one point, the buckets, if travelling at a high velocity, would be shot up into the air at every support, and might not always come down upon the line again. The line itself does not provide a sufficiently rigid road-bed for the passage of even moderate weights at high speed; but it shows that all that is needed can be done when it is required. Thus, instead of a mere rod of steel as the rail, with a carriage suspended from grooved wheels, the line for fast traffic would be a practically rigid bar of iron, and wheels so arranged that they could not by any possibility leave it, while for passenger traffic it might take the form of the letter A in section, the carriage body hanging down on each side, as suggested for light railways in mountain districts. There is, in fact, no difficulty in devising the requisite mechanical details, when the electrical arrangements are perfected; it is simply a question of which plan is the best, taking into consideration economy in construction, durability, and efficiency. The method of conveying the current above described, is that known as the series system; but Profs. Ayrton and Perry have devised one known as the "cross-over parallel," in which the insulated and uninsulated lines cross one another at intervals, and thus furnish insulated and uninsulated sections for two lines—the up and the down. The governing arrangements and the absolute block devised by Profs. Ayrton and Perry, have helped to perfect the scheme of Telpherage invented by Prof. Fleeming Jenkin, which he modestly says is not likely to compete with railways or injure their traffic. At first the Telpher lines will no doubt be used mainly as feeders for railways, and as a simple and rapid means of conveying articles from one part of a large works to another; but they will not stop there, for with the growth of the parcels post it is not unlikely that the Post-office will eventually possess a Telpherage system, and become altogether independent of the railways.

A NEW MAGIC-LANTERN.

MR. J. B. MEDLAND, of 12, Borough, London Bridge, is introducing a new lantern, the lamp of which has no fewer than five wicks (an engraving of which we give), to which he has given the name of the "Pentaphane," or fivefold light. Besides the improvement in the lamp, there are some others not before met with in the ordinary lantern. As will be seen, the shape is somewhat different—the square front carrying the objective being an arrangement for exhibiting opaque objects, which has hitherto been accomplished by a separate piece of apparatus, the aphengescope, the use of which necessitated altering the position of the lantern, whereas in this case it is effected almost momentarily. For exhibiting transparencies, the objective is screwed into the bottom flange, shown in the engraving, with a cap screwed in to exclude the light when not in use. The light from the lamp passes through the condenser in the ordinary way to the objective. When required for opaque objects, such as a C.D.V., medal, works of a watch, &c., &c., all that is required to be done is simply to screw the objects

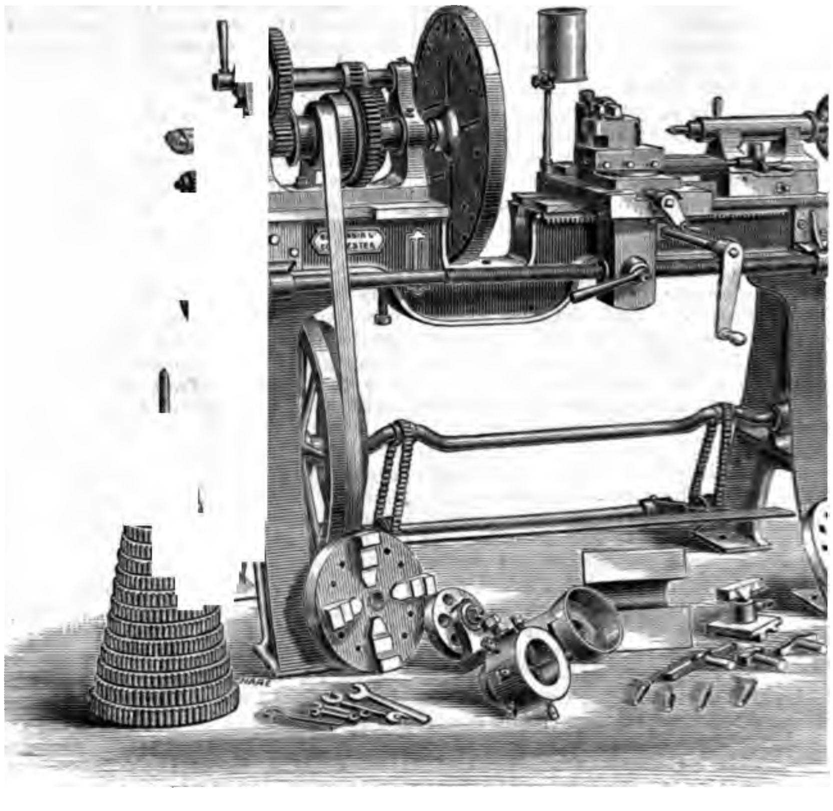
VOL. XXXVIII.—NO. 977.



into the top flange, as shown in the engraving. The flat mirror shown at the bottom is then brought into use, and fixed at a proper angle to throw the light from the condenser back on to the object by a piece of metal drilled with a number of holes, and a pin fixed beneath. The object is then reflected through the objective on to the screen. This arrangement will be found very serviceable for introducing many interesting objects in the course of an exhibition, which otherwise could not be done without first having them photographed and made into slides in the ordinary way. The five wicks of the lamp are arranged parallel, and the light given is, certainly, one of most intense brilliancy and, for transparencies, all that can be desired for schools or moderate sized lecture rooms. The difficulty of the accurate adjustment of the wicks, so as to avoid smoke, &c., from so many burners, is obviated by a very simple but, at the same time, very effective arrangement of a fan or shutter placed in the iron chimney of the lamp, as shown in the engraving, which regulates the current of air so that, when the flames are left at a moderate height all level, by turning the fan the current of air is increased, and the combined flames drawn upwards and towards the centre, where the greatest amount of illumination is, of course, required. The lantern appears to be well made in all its parts, is fitted with 4in. condensers and portrait combination objective; and is made exceedingly portable, packing into a light iron case only [illegible]in. by 7½in. by 13in., and we should think, leaves nothing to be desired by those who wish for a compact and complete instrument ready at a moment's notice.

BRITANNIA COMPANY'S NEW "NAVAL" LATHE.

THE Britannia Company, of Colchester, are introducing a new extra strong lathe for [illegible], especially designed for the British [illegible]. The bed is [illegible] long, 8½in. on face, [illegible] height of centre, 6in.; size of gap, [illegible] will swing 2ft. diameter, [illegible]. It has three speeds on cone, 9in., [illegible] band. The head is fitted with [illegible] pitch, 1¼ face; two [illegible] to alter the speed to either single, [illegible] Steel leading screw is [illegible] pitch. These lathes [illegible] to do very heavy work by [illegible] where [illegible] are [illegible] cannot be obtained [illegible] in., [illegible] 9in. bed, [illegible] do [illegible] for [illegible] ships where space is limited. They are fitted with a full assortment of chucks and tools of corresponding strength; longer beds when required. As an instance of the work, a 24in. wheel or plate can easily be turned by foot-power by use of the treble gear. By using the double gear this will take a ½in. cut off a 2in. or 3in. shaft. The treble gears are used on larger articles up to 24in. Total weight of lathe and tools, 14cwt.



HOW TO MAKE A CHEAP LATHE.—IV.

Mandrel Details.

IN our last, we left our headstock castings prepared ready for the reception of their fittings. Taking now the headstock proper, "the last headstock," as it is usually termed, le make its mandrel (Fig. 25).

Get a piece of 1in. round steel rod : on this have two collars welded out of ¼i rod, and at a distance of 1¾in. betw inside of the first ring being 1½in. dist the end. Centre pop each end, and in into which the back centre will run, d hole about $\frac{3}{16}$in. or ¼in. deep, using a archimedean drill for the purpose. insures concentric wear in the mandrel acting in the function of a guide to point of the dead centre (Fig. 26) whic absence of the hole, would grind the end eccentric (Fig. 27).

Chuck between dead points, using tl (Fig. 28), and turn the end which is t the rigger to ⅞in. diameter. Use a to like Fig. 29, taking a rough cut first, a: a fine one. Then change ends, putting just turned into the carrier, and turn th that runs in the brasses, the collars screwed part to dimensions (Fig. 25). your borrowed lathe is suitable for screw having the necessary change wheels, cu thread of 8 to the inch on the nose of drel, using a tool like Fig. 30. A cha run along half a dozen times will impar to it. If, however, no screw-cutting arra is available, better to have the man chuck-screws cut by a machinist, tha stocks and dies

Now slip the front collar or the nos mandrel into one of the holes of a cc (Fig. 31). Put a drill ⅜ $\frac{1}{32}$in. diameter slide-rest, and drill a hole with it 1¼in. c the mandrel nose; cut a ½in. thread with taps, the taper one first, and the stum wards.

Now file a flat ¼in. wide for the ke rigger, reaching to within an ⅛in. of the and hand the mandrel over to the smitl hardened where the point of the back centr

For the back centre, turn down a piece to ½in. diameter by 2¾in. long, tapering which forms the centre to an angle c thereabouts. Screw it about ¾in. from c then have the point hardened. Provide of nuts for it (Fig. 32).

Make the rigger of hard wood—a piece dry hard wood will do—oak, ash, or beecl pare two metal discs, either cast brass or of plate (Fig. 33) 2¼in. diameter by ⅛in. thick, drill a ½in. hole in the centre of ea three holes, countersunk for wood screw circle 1¾in. diameter. File a keyway i ¼in. wide by ⅜in. deep, or rather $\frac{1}{32}$i than ⅜in. in one plate, and ⅛in. in eeth

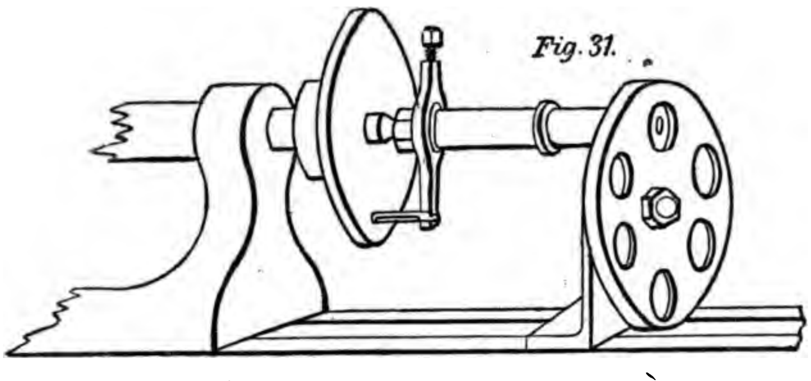


Fig. 31.

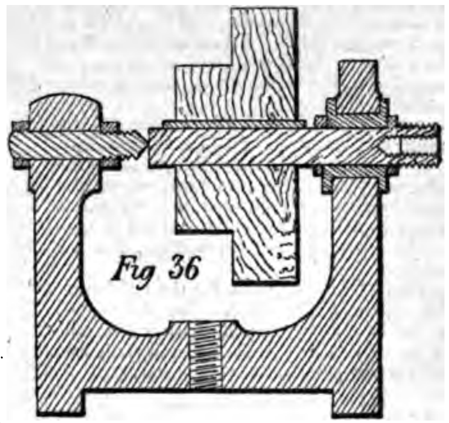


Fig 36

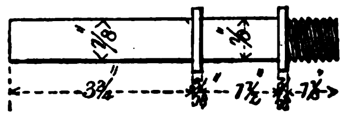


Fig 25.

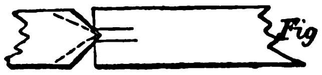


Fig 26

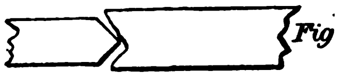


Fig 27.

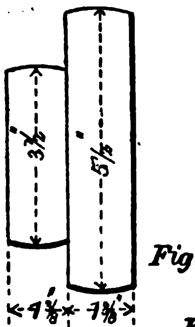
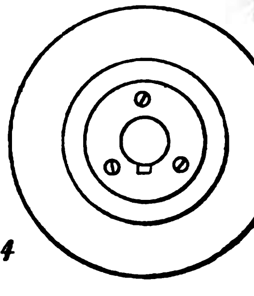


Fig 34



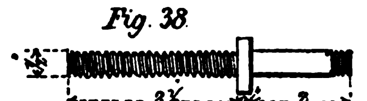


Fig. 38

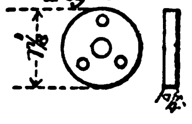


Fig. 39

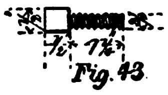


Fig. 43

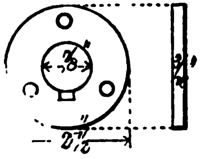


Fig 33

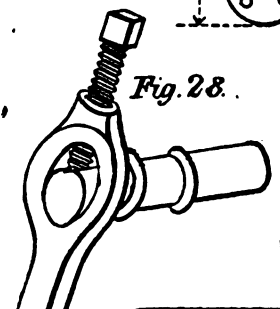


Fig. 28.

Fig 40.

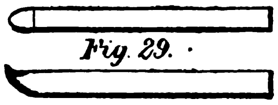


Fig. 29.

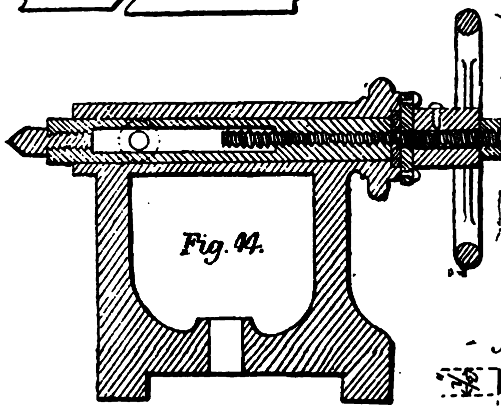


Fig. 44.

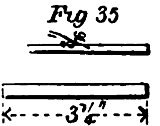


Fig 35

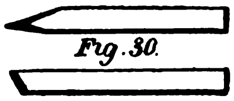


Fig. 30.

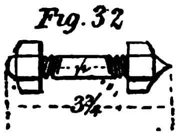
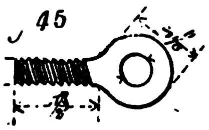


Fig. 32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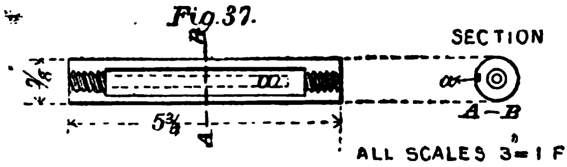
Fig. 37.

ALL SCALES 3" = 1 FOOT EXCEPT FIGS 41 & 42.

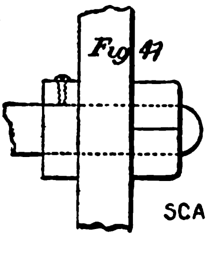
Fig 41

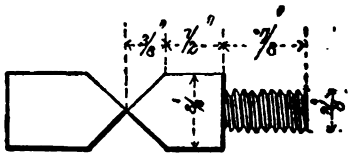
Fig 42.

SCALE HALF SIZE

in the other, to give the necessary taper for the wedge. These plates will be let into the block of hard wood intended for the rigger. Prepare the stuff to 6in. diameter by $2\frac{3}{4}$in. thick in the rough, screw it on the face plate, bore a $\frac{7}{8}$in. hole through it, using the gouge and the corner of a side-chisel. Turn a recess $2\frac{1}{2}$in. diameter to a depth equal to the thickness of one of the discs, hammer the disc into place, and screw with $\frac{3}{4}$in. or 1in. screws. Rough down the wooden block to $5\frac{5}{8}$in. diameter, take it off the plate, and rechuck by the finished face. Let the second disc into the other side, keeping the keyways in line with one another, remove from face plate, drive tightly on a mandrel, and turn the two speeds to dimensions, not forgetting the slight rounding (Fig. 34). Cut keyway through the wood from plate to plate, file a key out of $\frac{1}{4}$in. iron or steel rod to dimensions (Fig. 35), and key rigger in position. Place in headstock, of which Fig. 36 now presents a sectional appearance.

For the poppet mandrel (Fig. 37) get a piece of thick $\frac{3}{8}$in. wrought-iron tubing, 6in. long and not less than $1\frac{3}{8}$ diam. outside—what is known in the trade as "hydraulic pipe"—and instruct the smith to weld a short bit of $\frac{5}{8}$in. bar, about $\frac{3}{4}$in. long, into each open end, in which to cut the necessary threads for the traversing screw, and the dead centre. In a small mandrel this is a readier method than drilling up a solid piece of metal, and fitting in a nut for the back screw. When welded, centre pop the ends, chuck in the dead centres with carrier, and turn to a sliding fit with the bore of the poppet head. Remove the poppet centre, replace with the cone plate, and drill at one end a $\frac{3}{8}$in. tapping hole for the dead centre, then re-chucking, drill at the end opposite a $\frac{1}{2}$in. tapping hole for the traversing screw. Remove from lathe and cut the screws.

Make a slot in the mandrel 4in. long by $\frac{1}{4}$in wide by $\frac{1}{16}$in. deep (Fig. 37, *a*, *a*) for the tightening screw. To cut the slot, get a cold chisel $\frac{1}{4}$in. wide, keep it sharp, and chip as near to size as possible, just cleaning a little with the point of a file afterwards; but the revolving cutter of a slotting machine, if at our service, would almost run it out while we are talking about it.

For the traversing screw, get a piece of $\frac{5}{8}$in. rod $5\frac{3}{4}$ long, have a collar $1\frac{1}{4}$in. diam. by $\frac{1}{4}$in. thick, welded on at a distance of $3\frac{1}{2}$in. from one end. Turn in lathe to dimensions (Fig. 38), trying the collar in the corresponding recess in the poppet to get an easy fit, and keeping it just a shade thinner than its recess is deep, so that it may not run tightly when the back plate is screwed on. The screw may then be cut either in the lathe or with stock and dies. If the latter are used, care should be taken to keep the stock square with the axis of the traversing screw.

For the back plate (Fig. 39) make a disc of wrought iron or brass, $1\frac{7}{8}$in. dia. by $\frac{1}{4}$in. thick, drill a $\frac{1}{2}$in. hole through its centre, and three holes in a diameter of $1\frac{1}{4}$in. to take three small $\frac{3}{16}$in. screws. Slip this over the end of the traversing screw, thrust the screw collar into its recess in the poppet, and mark three holes with a scriber point on the back of the poppet, corresponding with those just drilled in the plate. Centre pop, drill $\frac{1}{2}$in. deep, and tap these three poppet holes with any convenient tap about $\frac{3}{16}$in. in diameter. If you have a screwplate, one of the taper taps of the set will do for entering, and you can either make, or get a fitter friend to make for you, a stump tap cut with the same thread to finish with. Get some lock screws, mushroom-headed, such as carpenters use, cut them off $\frac{3}{8}$in. from the bottom of the head and screw with plate, so that they will fit the tapped holes (Fig. 40).

Now bore the hand wheel to $\frac{1}{2}$in., slip the disc over the end of the traversing screw, then the hand wheel against the disc, followed by a tightening nut. Then drill a $\frac{3}{16}$in. hole through boss of wheel and spindle, and drive in a bit of steel wire—or, neater still, tap a $\frac{3}{16}$in. set screw through one side of the boss into the spindle (Fig. 41).

For the dead centre get a piece of $\frac{3}{4}$in. steel, and turn down to dimensions as shown Fig. 42.

The part A simply indicates a surplus length for the attachment of the carrier, and is cut off on removal from the lathe. Screw with ⅜in. dies, chuck in a block of hard wood, and file the centre to a nice point in the lathe, giving it afterwards to the smith to harden.

Make a set screw to dimensions (Fig. 43) for tightening the mandrel. Put in the mandrel, make the traversing screw take into it, screw the backplate in place, also the hand wheel and tightening nut, and run the mandrel backwards and forwards with oil several times till it goes easily. The poppet, now in section, has the appearance of Fig. 44.

Have a small forging made for the tightening screw of the rest (Fig. 45). Let the looped portion be forged solid, and drill a ⅜in. hole through it. Cut the ½in. thread, and drill and tap similarly the boss on the rest socket.

DARWIN'S ESSAY ON INSTINCT.

THE so-called "posthumous" essay of the late Charles Darwin, which it appears was written thirty years ago, was read at the recent meeting of the Linnean Society by Mr. G. J. Romanes, in whose forthcoming work on the "Mental Evolution of Animals" it will form an appendix. The essay was, it seems, penned by Mr. Darwin as a preliminary to some chapters for his "Origin of Species," and the following is an outline of the paper, arranged under the several topics to which it relates:—

Under the head of migration the main points with which Darwin is concerned are—(1) That in different kinds of birds there is a perfect series, from those which occasionally or regularly shift their quarters within the same country to those which periodically pass to far distant countries; (2) the same species often migrates in one country, and is stationary in another, or different individuals of the same species in the same country are migratory or stationary; (3) the migratory instinct is made up of two very distinct factors — viz., an impulse to travel periodically and a faculty of knowing the direction in which to travel; (4) savage man shows a sense of direction which may be analogous to that shown by migratory animals; (5) certain cases are on record of birds or domestic animals having truly migratory instincts—a fact which is specially pronounced in the case of a breed of Spanish sheep. Such being the *data*, substantiated by a number of facts, Mr. Darwin proceeds to consider the problem of the origin of the migratory instinct. This theory is that the ancestors of migratory animals were annually driven, by cold or want of food, to travel slowly southwards, and that in time this compulsry travelling would become an instinctive passion, as in the case of the Spanish sheep. In the case of birds the wings would be used, and if in the course of many successive generations the land over which they flew in their annual journeys were to become slowly submerged, the line of flight would remain unaltered, and thus we should have the state of things which we now perceive—viz., migratory birds flying over wide stretches of ocean. In regard to instinctive fear, an accumulation of facts are given to show that the fear of man has always first to be acquired in a state of nature, and that under domestication it is merely lost again. The feigning death of insects and spiders is shown to be merely an instinct of remaining motionless, and therefore inconspicuous, in the presence of danger, there being thus no idea of death or of its similation on the part of the animal. A great array of facts is given to show that the instinct of nest-building is subject to variations, both on the part of the individuals and, in the course of time, on that of species. Hence it is argued, "If it be admitted that the nests of each bird, wherever placed, and however constructed, be good for that species under its own conditions of life, and if the nesting instinct varies even so little when a bird is placed under new conditions, and the varieties can be inherited, of which there can be little doubt, the natural selection in the course of ages might modify and perfect almost to any degree the nest of a bird in comparison with that of its progenitors." Applying a similar class of considerations to these as to the nests of birds, Mr. Dawin shows that variations of instinct have occurred in rats, which now uniformly inhabit roofs of houses instead of hollow trees, &c; in the hyænas of South Africa having ceased to make burrows, and so on. He also shows how the lodge of the beaver might have been developed out of such a habitation as is made by the musk rat. After adducing severally unusual striking instances of variation of instincts, Mr. Darwin observes:—"As there is often much difficulty in imagining how an instinct could first have arisen, it may be worth while to give a few, out of many, cases of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, *give rise to such." After adducing* several such cases, the essay goes on to consider cases of special difficulty presented by sundry instincts to the theory of natural selection.

Prof. Huxley said he could not but think that this was not a matured work of Mr. Darwin's, but consisted simply of a series of notes made for his own use out of the immense stores of information which he had acquired, and which he intended to digest and bring into complete harmony with his great scheme as published in "The Origin of Species." Prof. Huxley would not have been sorry had the paper been left in the unfinished, unpublished state in which Mr. Darwin left it. It had added nothing to the ideas which already obtained on the nature of instinct, and the illustrations were not of so unknown, rare, and unheard-of a character as to help them to any further comprehension than they already possessed of the extraordinary phenomena which had been grouped together under the name of instinct. He knew of no subject more interesting than this, from its bearing upon the intellectual phenomena of the higher animals, man in particular. Any discussion of this subject from Mr. Darwin would have been profound and valuable, and would have thrown light on one of the greatest chapters of scientific inquiry; but the paper was simply a series of statements, many of which were familiar to most of them, and many cases were difficult to reconcile with the view of creation, or the world of life, which was a phrase he preferred which proceeded upon the hypothesis of use either individual or special. In regard to some of these it might be said that there was not a clearer illustration of the view that the world was not constructed upon any plan which did, upon any attentive consideration, produce amiable feelings in the breast of the philanthropist. The world was hard, full of struggle and pain; it was a world in which the weakest went to the wall; where there was a waste of life and of suffering absolutely incommensurable with the results obtained. Mr. Darwin would, no doubt, on careful consideration have modified may of the views expressed in the paper, and he rather regretted that in this unfinished state it should have been given.

Prof. Allman expressed the opinion that the great value of the paper lay in the fact that the different cases of instinct mentioned in it had been accepted by Mr. Darwin from observations of his own and others. They knew his judgment and skill in observation, and what a truthful record he made of his observations; they might, therefore, accept without hesitation both the instances noted in the paper which were the result of Mr. Darwin's observations and also of those which he had accepted from others.

Mr. A. R. Wallace said there was, to his mind, a considerable amount of obscurity about what was really meant by instinct. It included a considerable number of phenomena, some of them mere results of muscular and nervous co-ordination, and in other cases simply the results of observations and experience. Referring to the supposed instinct guiding the migration of birds, he said the present state of facts tended to show that there was no such power at all, but rather led to the belief that this migration was one of the means of getting rid of the enormous surplus of bird population, as it had been proved, especially by the observations promoted by the British Association at lighthouses and Heligoland, that of the vast numbers of birds which sought to pass from one region to another only a small proportion survived.

Prof. Ray Lankester wished to know whether Mr. Wallace abandoned the supposition of instinct altogether. He thought there were many instances which might be adduced which could not be accounted for on the theory of observation or of having learnt from others, and referred especially to certain habits of the caddisfly in support of his contention. He asked, also, why birds, for example, should go to the west and not to the east in their migration. These things required further investigation, and they must not draw any conclusion from what had been brought before them, as that the phenomena referred to were, if necessary, to be explained by instinct or the reverse.

FRAME FOR PRINTING LANTERN SLIDES.*

TO print transparencies for the lantern by contact when the negative is of a larger size than the picture required necessitates some special kind of printing frame, if the negative is to be kept free from scratches. The following may be simply made, and will be found a great convenience where a number of pictures are required alike:—Take an ordinary printing frame, say a 12 by 10, of the kind made to use without a plate-glass in front, and in the rebate where the negative is usually placed fasten, with strips of paper all round the edges, a piece of very flat glass; turn the frame over, and on the other side of the glass fasten a mask of paper or cardboard having an opening 3¼ by 3¼in. exactly in the centre. Now, in place of the ordinary hinged back, make a frame of the same size and thickness, with an opening in the centre about 6 by 4in., and cover all over one side, with the exception of the opening, with a piece of velvet. This frame, when placed in position, will be held by the springs that originally held the hinge back. To complete the arrangement, cut out a piece of dry mahogany an inch thick, and exactly 6 by 4in., to accurately fit the opening in velvet-covered board, and on this block draw a square 3¼ by 3¼in. exactly central. At one end of this square glue down a very thin slip of hard wood—that is, rather thinner than the glass plates to be used—and at the other end cut a mortice 3¼in. long, and about an inch wide, right through the block, beginning just within the 3¼ line, say a sixteenth of an inch less. Into this mortice fit a piece of wood 3¼ by 1 by ¼in. On to one side of this piece glue a similar strip of hard wood to that placed on the end of the block only, projecting ¼ of an inch each end, and on the other side screw a similar piece so that it can be removed. Place the piece in the mortice and screw on the back slip of wood; there will then be left a space of half an inch at the end, just room to put a piece of bent steel clock spring, sufficiently strong to clip the 3¼ plate in position. The sides of the block may be rebated down half an inch at the 3¼ line to allow the thumb and finger to adjust the plate in exact position. To complete the frame, place the block in the opening of velvet board, and arrange an ordinary brass pressure frame spring to keep it in position. For use, take the frame, remove the board, and adjust the part of negative required over the 3¼ opening, then place over the velvet-covered board, and fasten down the springs. The 3¼ plate is now clipped in the block, and dropped carefully into the opening over the negative, and after exposure is lifted out in the same way, so that any number of exposures may be made exactly registered in the same position, without the chances of injury to the negative which often occurs unless some such arrangement is adopted.

USEFUL AND SCIENTIFIC NOTES.

Lubricating Oils.—According to a German technical journal, the manufacture of machine oils is simple and very easily carried out. Any fine non-drying oil can, after refining and purifying, be used as a lubricating material. Cotton oil takes the first place among all the fatty oils, and but for its price would be employed much more frequently than it is. Poppy oil, croton oil, radish oil, &c., are comparatively little used. Sesame oil, almond oil, earth-nut oil, and rape oil are better fitted for the preparation of machine oils, and the last named, being the cheapest, is more used than all the others. It is never perfectly pure as met with in commerce, and must therefore be refined. Various more or less satisfactory methods of refining it have been employed—for example, those in which sulphuric acid, oxide of zinc, oxide of lead, potash lye, potassium bichromate, and sulphuric acid are employed. An oil almost as clear and transparent as water is obtained in the following manner: 100lb. rape oil are heated to 167° Fahr., and washed with 3lb. of potash lye of 30° B.; after about 10 to 12 hours the oil is transferred to a clean vat, left to cool down to 116°—99° Fahr., stirred and mixed with a solution of ¼lb. potassium bichromate, 1¼lb. hot water, and 1½lb. of sulphuric acid (22° B). The mixture is then washed with a sufficiency of hot water, left to stand for some hours, and the purified oil is filtered off from the impurities present. An excellent machine oil consists of 50 parts of rape oil mixed with 100 parts of mineral lubricating oil.

Preserving Iron Surfaces from Oxidation.—Pulverulent zinc is mixed with oil and a dryer, and the mixture is applied with a brush. For ordinary exposure, one coating of this mixture is affirmed to be sufficient, but a double coat, it is claimed, will afford a sure protection against both the atmosphere and sea water. A good formula for this zinc paint is the following: Zinc in powder, 8 parts; oil, 71 parts; driers, 2 parts. The mixture should be prepared freshly, and only so much made as is required for the time. The zinc coating imparts to the iron a steel-grey colour, and does not interfere with the application of another coat of paint.

THE owners of the railroad up Green Mountain on the Mt. Desert in Maine, U.S., propose building an electric railroad for summer pleasure travel on the island from Bar Harbour to Eagle Lake, where connection will be made with the steamboat running across the lake to the terminus of the Green Mountain Road. The distance is three miles.

AT the Swiss Congress recently summoned to discuss the subject of the Patent Law, resolutions were passed, by 110 votes to 52, recommending the Government to adopt some measure for the protection of inventions. No opposition was offered to the introduction of a "Trade Mark" law.

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* By ALEXANDER COWAN, in Photographic News.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE second meeting of the session of the above society was held on the 14th ult. at King's College, Strand; the President, Prof. P. Martin Duncan, F.R.S., in the chair.

Mr. Stewart exhibited his simple safety-stage, a small contrivance intended to remedy a want which he had often felt of some simple method of preventing slides from being broken by careless focussing down upon them during class demonstrations. Having frequently lost valuable slides in this way, he had thought of a simple plan which Mr. Curties had carried out for him, and which he described to the meeting by means of a drawing on the blackboard. It consisted of a piece of wood the size and thickness of an ordinary glass slide, with a hole in the centre sufficiently large to admit the light to the object. Between this hole and the sides of the slip of wood two small strips of wood were fixed, and on the top of each of these a thin strip of brass was fastened, the brass being longer than the wood, and so overhanging it at each end. A couple of indiarubber rings were then passed over these projecting ends, so as to lie crossways to the slide, and on these, suspended in a kind of hammock, the slide it was desired to protect was placed. If, then, the objective was brought down upon the cover glass the indiarubber yielded to the pressure, and the object was saved from destruction. He was aware that there were other safety-stages in use, but thought this supplied a want which had been felt for something quite inexpensive, and yet perfectly efficient for the purpose.

Dr. Anthony said he had for the last 30 years, in the course of his microscopical observations, attained the same result by simply having the stage of the instrument made narrower than usual, so that the slide slightly projected beyond the edge. When a high power was used, all that was necessary was to tilt the slide with the finger, and it could be at once felt or heard when the objective came in contact with it whilst focussing down. Ross had somewhat improved upon this plan by having a very thin plate made, by means of which the slide could be raised in a similar manner.

The President said there was no doubt that in exhibiting objects to a class of medical students something of this kind was very necessary; and as they were not particularly careful or experienced, the plan of tilting the slides was not of so much use; but he thought the admirable little plan described by Mr. Stewart quite met the difficulty. For his own part, he could say that he had some slides which he had never ventured to show because of the danger of getting them broken in this way. One idea which appeared to be useful was to have a piece of cork fitted on the slide, so that the shoulder of the front of the objective would come in contact with it before it touched the cover.

Dr. Matthews said he had much felt the want of something of this kind, for it was only during the previous week that he had demolished a slide in that way, and this not from any particular carelessness on his part, but from inadvertence, the microscope being shaded and the lamp turned down, so that he was almost in the dark at the time the accident occurred.

Mr. J. Mayall, jun., said it appeared to him that the inventors of "safety-stages" had hitherto claimed for their devices far greater practical utility than they really possessed. It had been suggested some time ago that the use of a safety-stage secured practical immunity from breakage of slides, however short might be the working distance of the objective. Without doubt, so long as the operator limited himself to illuminating the object by the mirror or equivalent means, the safety-stage would protect the slide during careless focussing, or from injury by accidental concussion of the eyepiece. But when high powers were in use, just when the safety-stage might appear to be of service, a new factor had to be considered—in the majority of cases it became necessary to use some form of condenser, which had generally to be racked up in contact, or very nearly in contact, with the base of the slide. The slide was thus in danger of being squeezed between the objective and the condenser, and this applied equally whether the safety-stage were used or not. In such a case, the action of the safety-stage was practically nil as regarded the protection of the slide. As he understood Mr. Stewart's intention in devising his new form of safety-stage, its use was expected to be limited to class demonstrations where sub-stage condensers would not be applied, and where the students were only too apt to regard the breakage of a slide as of no moment. With that purpose in view, he thought Mr. Stewart had hit upon a very simple and effective device.

Mr. Stewart said it was intended entirely for rough purposes when exhibiting slides to students and others who were not very careful in such matters.

Mr. Crisp said that it was not unusual to hear derision of these safety-stages; but it came from Fellows who were all experienced workers, and to whom any such contrivance was superfluous.

Dr. Coffin said that he had employed a similar contrivance for some time; but it was simply made of a piece of brass wire bent into a fork somewhat wider than the slide, the two ends of which were bent back again, and across which the two indiarubber bands were stretched.

The President inquired if any Fellow had tried to meet the difficulty which Mr. Mayall had mentioned with regard to the condenser? Perhaps a piece of brass projecting so as to catch on the shoulder of the objective might answer the purpose.

Mr. Watson's nose-piece adapter and those of Dr. Matthews were exhibited by Mr. Crisp.

Dr. Matthews, in reply to a question as to the firmness with which his adapter would hold an objective, said that, as a proof of how firmly this kind of connection would grip, he might say that a 1in. bolt could be screwed in a lathe at one operation in a chuck which was only fitted to the head stock by a coned joint.

Mr. Ingpen thought that in the case of the lathe chuck the screw pressed strongly against it during the operation, and that this pressure of course increased the cohesion of the surfaces; but in the case of an objective there would not only be no such pressure, but the weight would act the other way.

Dr. Anthony inquired if any provision was made as regarded the centring of the objective, supposing that it was interfered with, by this mode of connection.

Mr. Ingpen said that coning was the nearest approach to perfect centring that could be obtained.

Dr. Matthews said that all objectives were open to the difficulty of centring because each had its own centre, and no two of them were alike. To get accuracy they must be fitted to the instrument on which they were to be used. Those which were coned were no worse in this respect than others; possibly they were better.

Prof. Abbe's analyser was explained by Mr. J. Mayall, jun., by means of a blackboard diagram.

Mr. J. Mayall, jun., exhibited and described a pocket lens of 1in. focus on a new formula by Dr. Schröder.

Mr. Ingpen asked if the lens was considered to be superior to those of Steinheil.

Mr. Mayall said he had recently the opportunity of comparing a 1in. of Steinheil with the new 1in. of Dr. Schröder, and the latter was superior both as regarded length of working distance and more perfect achromatism.

Mr. C. Beck remarked that the working distance of the new lens was nearly an inch.

Mr. Crisp read a paper "On Optical Tube Length: an Unconsidered Element in the Theory of the Microscope."

Dr. Anthony said that the important point to ascertain in future was the value of Δ or the "optical tube length," and he thought this was a matter which might be easily got at.

The President said it followed from the paper that in consequence of the variation in the optical length, they could not formulate any table of magnifying powers which would be of general service. The data for a correct table must be obtained by actual measurements of the focal lengths of the objectives and eyepieces employed.

Prof. Abbe's paper "On the Relation of Aperture to Power," Part III., was read by Mr. Crisp.

Mr. J. Mayall, jun., said he could not agree with the statement contained in Prof. Abbe's paper—that eyepiece power beyond six or eight diameters was of little or no service. He thought Prof. Abbe had fixed upon too low a limit. In viewing double stars, for instance, with a fine telescope, it was unquestionable that eyepiece power far beyond six or eight diameters was of service, for it was in everyone's experience who had used such an instrument, that eyepiece power of 40 and more was, in many cases, required before the separation could be discerned. So also with the microscope. It was a fact that, with a deep eyepiece—and by a deep eyepiece he meant a power of 10 to 40 diameters—many images, such as the resolution of Nobert's lines or the finest diatoms, were rendered visible which could not be seen with one of less depth. He might mention, too, that this point could hardly yet be said to have been settled by theory, for, in discussing the subject recently with M. Prazmowski, of Paris, than whom he did not know a higher authority, that gentleman stated that not only did he regard the question of the useful limit of eyepiece power as still an open one; but he also considered the absolute relation of the aperture to the resolving power required the confirmation of experiment before he could give it his unqualified adhesion. He (Mr. M.) might safely bracket Dr. Schröder's authority with that of M. Prazmowski, between whom these subjects had been discussed any time during 20 years past. Dr. Schröder considered the questions still open, and he was actually engaged in computing a formula for an eyepiece for the microscope to give 40 diameters; whilst, with regard to the limit of resolving power of objectives of a given aperture, he considered the theory too incomplete to warrant any definite limit being assigned. Mr. Mayall thought he might appeal to the experience of English and American microscopists in general, in proof that eyepiece power far beyond the limit assigned by Prof. Abbe—six or eight diameters—was of service in bringing to view microscopical details which could not be seen with less eyepiece power. From his own experience in testing some of the finest objectives hitherto made, he was bound to say the useful eyepiece power was very much a question of the real perfection of formula and workmanship of the objective.

Dr. Anthony said he could emphatically endorse the remarks which had been made. Every microscopist knew by experience which of his battery of eyepieces suited his purpose the best, according as he wanted to see the relative position of the parts of a structure, and if he wished to see through several planes he would go on using his eyepieces until his objective "broke down"; but if they had an objective which would bear the deeper eyepieces, C, D, and so on, they knew that they were able to get a great power of separation, and then found that there were thousands of lines which could not be appreciated before, because they were not grasped by the eyepiece.

The meeting was then adjourned to the 12th inst.

The following exhibits were made:—

Mr. C. Beck exhibited "Beck's Pathological Microscope and Condenser."

Mr. Crisp exhibited (1) Microscope made by the "Société Genevoise pour la Construction d'Instruments de Physique," a movable table for drawing with the Camera Lucida; (2) Swift and Sons' Pocket Microscope; (3) Harris's Pocket Microscope; (4) Zeiss's Micrometer Eyepiece; (5) Millar's Multiple Stage-plate; (6) Bausch and Lomb Optical Co.'s Compressors; (7) Valentine's Hot Stage.

Mr. Curties exhibited Aylward's Collecting Apparatus.

WESTERN MICROSCOPICAL CLUB.

THIS club held its usual monthly meeting on Dec. 3rd, at the house of Dr. B. Thompson Lowne, F.L.S. The subject for illustration was "The Microscopical Structure of Eyes," more especially the wonderful "compound" eyes, as they are called, which are found in insects, crustacea (crabs, lobsters, spiders, &c.), and other members of the order Arthropoda. When it is borne in mind that each of the two eyes of insects is an aggregate of smaller eyes, amounting in the case of the dragon-fly to at least 25,000 separate lenses, it will be seen that some interesting questions arise as to the kind of picture which is presented to the possessor of this astonishing plurality of visual organs, the chief problem being whether or not the picture presented to the insect is a multiplication of the objects of visions corresponding to the number of the lenses in each eye. To illustrate this part of the subject, the host gave some interesting demonstrations of the views he has set forth in a paper contributed to the Royal Society. The specimens exhibited by Dr. Lowne and other members were curious and interesting. Different stages in the development of the compound eye were exhibited, the earlier structure in the pupa of a moth, and of the more advanced and perfect insect, being among them. Microscopes were brought by Messrs. E. Bartlett, L.D.S., J. Dolleymore, B.Sc., J. W. Groves, F.R.M.S., G. Karop, M.R.C.S. S. P. Moore, LL.B., E. M. Nelson, H. V. Tebbs, and A. W. Stokes, F.C.S. Among the objects exhibited were sections of eyes of dragonfly, blowfly, "jumping spider," and a fly of the species Syrphus. Passing from the compound eye of insects, there were specimens of the eye of molluscs or shellfish, which have their eyes on their backs and other parts of their bodies, developing them in the most sporadic manner. It was mentioned that the common scallop of the fishmongers' shops has no less than ninety separate eyes along the fringe of its "mantle," and a case was mentioned in which a mollusc which is preyed upon from above by a fish has (according to Semper) developed eyes on its back as a precaution against such enemies. The cornea and retina of frog, together with the stellate pigment of the human choroid, variously stained, were also shown. Mr. W. J. Milles, F.R.C.S., brought some exceedingly interesting sections of the human eye in various forms of disease.

THE AMATEUR MECHANICAL SOCIETY.

THE annual conversazione of the Amateur Mechanical Society took place on Wednesday, the 5th inst., at the Gallery of the Society of British Artists, in Suffolk-street, Pall Mall. A large number of members and their friends attended, and in addition to the work shown by them, there was an unusually good display of professional exhibits. Amongst the amateurs General Clarke, C.B., brought a beautifully executed cup and cover in ivory, which worthily sustained his well-earned reputation; Mr. Phillips showed a looking-glass frame, composed of turned oak, designed in the

the ancient Egyptian lattice work, used to [illegible]lows in place of glass, some illustrations of [illegible]ill be found in Vol. IV. of Mr. Holtzapffel's [illegible]late I. [illegible] Mr. Inwards had an elliptograph, [illegible] instrument to show the trisection of an [illegible] practical demonstration of the 47th proposition of the First Book of Euclid, and other [illegible] curiosities. Colonel Sandeman, an ingenious contrivance, intended, we believe, for the [illegible] in the shape of a small box, from [illegible] anyone desiring a post card could obtain it [illegible] in a penny—any other coin being [illegible] returned to the owner without the [illegible]. Ellis illustrated the use of celluloid for [illegible] of dental instruments, the colour [illegible] distinguish at a glance the character of [illegible]. Seyd proved the ability of an amateur [illegible] quantities of brass and iron in excellent [illegible] by means of Fletcher's gas furnace and [illegible]—the whole outfit weighing but a few [illegible] and many other gentlemen gave evidence [illegible] more or less successfully mastered the [illegible] of mechanical manipulation. Amongst [illegible] Messrs. Holtzapffel and Co. had an [illegible] large selection of their beautiful work, [illegible] a powerful [illegible] screw-cutting lathe, a [illegible] lathe, with slide rest, and a complete [illegible] of chucks, the whole, by clever packing, [illegible] in the drawers beneath. The slide-[illegible] lathe was furnished with a driving-[illegible] receive a band from the overhead drum, [illegible] as to be put out of gear by the pressure [illegible] against either of a pair of stops [illegible] rod fixed parallel to the main slide, thus [illegible] stops generally in [illegible] Evans showed a handsome lathe combined, and having in addition to the usual [illegible] an ingenious device for the equal [illegible]—a necessary adjunct for all [illegible] elliptic surfaces produced [illegible] "oval" chuck. Besides this and [illegible] other tools, he had a case full of ex-[illegible] specimens of turning, which seemed to have [illegible] attraction for the ladies. Mr. Syer [illegible] a watchmaker's bench, which we noticed [illegible] back—amongst the merits of which [illegible] be reckoned its moderate price [illegible] as other tools. Messrs. Churchill [illegible] large assortment of American tools, the [illegible] and excellences of which are now too [illegible] to need description, and the Aluminium Metal Company exhibited a number of [illegible] of their new alloy, the colour of which [illegible] that of silver. It is said to turn well, to [illegible] for lock fittings for yachts, railway [illegible] door-handles, locks, and other articles [illegible] freedom from corrosion is an advantage. [illegible] forming the Exhibition of the Society [illegible] Artists decorated the walls, and proved [illegible] to those who were not wholly [illegible] in admiration of the various mechanical [illegible] exhibited. In addition to those whose [illegible] have been incidentally mentioned, we [illegible] amongst the company Sir Lewis Pelly, Sir [illegible] Mr. Sant, R.A., Lieut.-Colonel [illegible] Dr. Edmunds, the Rev. S. B. Burnaby, [illegible] Mr. Livingston, and many others, [illegible] hon. secretaries, Mr. Bord, M.P., and Mr. Smith.

[illegible]following are the questions which have [illegible] addressed to the members of the society on [illegible] question of screw threads. Comparatively few of the members—not more than a third—[illegible] yet replied, so that the decision of the [illegible] will probably have to be postponed for [illegible] yet:—

[illegible] been accustomed to use a lathe furnished [illegible] the thread known as Holtzapffel's [illegible] for what description of [illegible]

[illegible] experienced any of the inconveniences [illegible] do you think that they [illegible]

[illegible] the present and future conveni-[illegible] desirable that the [illegible] the adoption of a standard [illegible] in the construction of their [illegible]

[illegible] the present system [illegible] what [illegible] you wish [illegible] to make in these [illegible]

[illegible] a new lathe, would you [illegible] and what special [illegible] and what important screws?

[illegible] possible by means of a [illegible] to secure the [illegible] especially the [illegible] with each [illegible] would you recommend for the [illegible]

[illegible] of the [illegible] the maker's name [illegible]

[illegible] in 1882 [illegible] by which passengers were

SCIENTIFIC NEWS.

THE great comet of 1882 does not seem to have been observed lately, and it is doubtful if any "position" has been estimated later than that for May 26 last, at Cordoba, where the comet was also detected on June 1. So lengthened a period of observation ought to enable the period of the comet to be calculated with more than usual accuracy, but at present Fabritius makes it 823 years, and Kreutz 843 years, the former being most probably the nearest.

In his address as President of the Royal Society, Prof. Huxley, speaking of Sir W. Siemens, said that "hardly any living man so thoroughly combined an extensive knowledge of scientific principles, with the power of applying them in a commercially successful manner; and that the value of his numerous inventions must be measured, not merely by the extent to which they have increased the wealth and convenience of mankind, but by the favourable reaction on the progress of pure science which they, like all such inventions, have exerted, and will continually exert."

Owing to increasing age, Prof. Owen has resigned the post of superintendent of the Natural History department of the British Museum, which he has held with much distinction for more than a quarter of a century.

Prof. Sylvester, it is said, is about to return to this country, having accepted a professorship at Oxford.

Besides the extraordinary phenomena witnessed during sunset and sunrise lately, we learn that a real blue moon was seen last week. The sky was red and the moon aquamarine on one occasion; and on another, the sky was orange and the moon a perfect sapphire blue, which we suppose means a deep blue.

According to the *Times*, though the dust of the dead mountains could not subjugate the sun in its strength, it has had force to "prolong its setting" and to determine the tone of the afterglow.

Referring to a paragraph in our Scientific News (p. 279), Dr. R. A. Hayes, physician to Dr. Steevens' Hospital, Dublin, sends us a brochure containing four microphotographs taken by him to illustrate Dr. Stack's paper on replantation and transplantation of teeth. The photographs are printed in colour by the Woodbury Co., to represent the staining of the sections, and are good examples of the skill of the photographer, and of the value of such photographs in illustrating papers of the kind.

At a visit recently paid to the Ben Nevis Observatory, the observer and his assistants were found in excellent spirits, and "quite at home." The visitors had to cut a path through the snow in parts, and on the summit found it six feet deep on the levels.

The Scottish Meteorological Society will shortly publish the observations of Messrs. Herdman, Beddard, and Hoyle, on the fisheries at Loch Fyne, Eyemouth, and Peterhead, together with the results of Mr. Norman's investigations as to the *food* of fishes in the Scottish lochs.

The inventor of the hot blast, Mr. J. B. Neilson, has now a monument to his memory, which has been erected by his son on Barstobrick Hill, near Kirkcudbright. It is in the form of a pyramid, 55ft. in height, on a base of 20ft. square.

The "standard time" has now been adopted on nearly all the railways in the United States, and has been followed, in one instance at least, by the further reform of reckoning the time of day from 0 to 24 o'clock. The Cleveland, Akron, and Columbus Railroad is the pioneer in this movement.

The standard time is sent from the Observatory at Washington at "75th meridian mean time," which is 8m. 12·09secs. earlier than Washington time, and when received at places belonging to the 90th meridian the clocks are set to 11 a.m. The "standard time" has already been adopted by many of the chief towns, and the "town clock" is now set in accordance with railway time.

M. Pasteur has shown that the bacillus of "rouget" as found in pigs can be attenuated by passing it through rabbits. The inoculated rabbits are all rendered very ill or die, but pigs inoculated with the bacillus, after the virus has been passed through a series of rabbits, have "rouget" in a mild form, and enjoy immunity from further attacks. A series of inoculations carried through pigeons, on the other hand, increases the virulence of the disease when a pig is inoculated from the last of the pigeons.

MM. Mouchot and Pifre have obtained a patent in this country for their solar engine; but it may be doubted whether they will find many infringers here until the climate is altered very materially.

M. Cartailhac has communicated to the French Academy of Sciences a description of some old flint mines in Miocene strata, near Mur-de-Barrez, Aveyron, which appear to have been worked by Neolithic miners. This is stated to be the first discovery of prehistoric mines in France.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

γ VIRGINIS—β 607 AND ARG. (—0°) 2,600—γ CASSIOPEIÆ—41 ARIETIS—β DELPHINI, &c.

[22120.]—MR. GEMMILL (letter 22036, p. 239) is correct in supposing that measures of the pos. angles of γ Virginis (and cognate stars) are not fairly indicative of the comparative brightness of either component; for this, the original observations must be consulted. His observations, if reliable, seem to point to rapid variability in either Arg. (—0°) 2,599 or 2,600. The former (β 607) was discovered to be double at Harvard in 1867, and has been observed at Cincinnati; the mags. agree very fairly. In remarking that "faint coarse pairs are not worth cataloguing," I referred, of course, simply to their being included as *double stars* in catalogues. I do not know of any particular authority for the variability of γ Cassiopeiæ; but Mr. G. is, doubtless, aware of its remarkable and almost unique spectrum, some recent observations of which he will find in *Ast. Nach.*, No. 2548. Smyth says, on page 21, of the *Bedford Catalogue*, "γ is suspected of variability," and then follow the words quoted by "F.R.A.S." on p. 290 of Vol. XXXVI. Flammarion gives the mags. of γ β and α Cass. on March 29th, 1880, as 2·0, 2·2, 2·5 respectively. Secchi seems to imply that it is *not* variable. I am not able to refer at present to other observations. The following are the principal measures of 41 Arietis other than those of Smyth, cited by "F.R.A.S.," on page 264:—

						Nights.
A—B	O.Σ.	255°·4 :	18″·79 :	1852·16 ;	11·5 mag.	1
	De.	260·6 :	20·59 :	1866·53 ;	11·2 mag.	3
	β.	265·8 :	21·18 :	1879·40 ;	10·8 mag.	2
A—C	H.	189·2 :	39·33 :	1783·70 ;		1
	O.Σ.	199·7 :	35·51 :	1852·16 ;	11·0 mag.	1
	De.	251·4 :	35·03 :	1867·70 ;	11·0 mag.	1
	β.	203·5 :	34·03 :	1879·40 ;	10·4 mag.	2
A—D	H.		125·58 :	1781.79 ;		1
	Sh.	226·6 :	127·56 :	1821·95 ;		1
	Σ.O.	228·7 :	127·40 :	1852·16 ;	9·0 mag.	1
	β.	230·2 :	125·90 :	1879·93 ;	8·5 mag.	2

The magnitudes are expressed in Σ.'s scale. The change is probably due to the proper motion of A, which, according to Mä. is 0·134″ annually in the direction of 158°. Smyth, in the MSS. calls B. indigo, C. and D. pale grey, and in the "Cycle" he says: "My friend, the Rev. W. R. Dawes, re-examined this object at my request in October, 1842, with results very similar to my own." I am not aware that Da's results have ever been published. Smyth quotes H's angle of A.C. as 188° 12′, but it is evidently 189° 12′, as the MSS. and printed catalogues agree; H marks his measure "very imperfect." Of A B, O.Σ. says, "Comitem exiguam primus Smythius conspexit." Is this a fact? [illegible] am unable to look up authorities at this moment, but I should be glad if Mr. Burnham, if he sees this, would say whether he knows of any measure of A B, other than Dawes's unpublished one, anterior to the publication of the "Cycle." Possibly Challis may have observed it; but it is a pity that the measures of double-stars made with the Northumberland equatorial have not yet seen the light. Ward has seen B steadily with averted vision with 2½in. Wray, but most observers would require a much larger aperture. In answer to Mr. Gaudibert's inquiries (letter 22099, p. 302) the following are β.'s most recent measures of β Delphini (182·5°: 0·23″: 3 nights; 1883·55) and δ Equulei (307·6°: 0·21″: 3 nights; 1883·55), from which it would seem that Mr. Gaudibert has actually succeeded in seeing δ Equulei also with 8½in. aperture—a feat upon which I must congratulate him. When at or about its greatest distance Dunér found it "oblongue, je suis bien sur" with the fine 9·6in. Merz, power 739, and this is the smallest aperture with which it has ever been seen. No one has ever succeeded in seeing the *comes* in the present quadrant before. Mr. Gaudibert should try the very unequal pairs η and τ Geminorum, and the exceedingly close equal pair 126 Tauri. The following are the most recent measures I possess of γ^2 Andromedæ; Hl. 99·4°: 0·33″: 3 nights; 1880·04; for comparison we have Hl. 101·90°: 0·38″: 5 nights, 1878·21; β 102·1°: 0·43″: 2 nights, 1878·65; β 107·9°: 0·36″: 1 night; 1880·06.

H. S.

MARE CRISIUM — REPORTING—FRACASTORIUS—JUPITER—DARK SPOTS IN ALPHONSUS—SATURNIAN DETAIL AND OBSERVATION.

[22121.]—I suppose it is the circumstance of my sketches of the Mare Crisium and Plato, in letter 22036 having been done in pencil, which is to blame for certain mistakes in their reproduction, which I will now enumerate.

Mare Crisium.—The ring of the crater marked D was seen complete. The ridge east of Picard was much more bent, curving westward just opposite the ridges marked B. The two craters west of the Pass were joined by a straight high ridge. The two mountains north of Picard E cast pointed shadows.

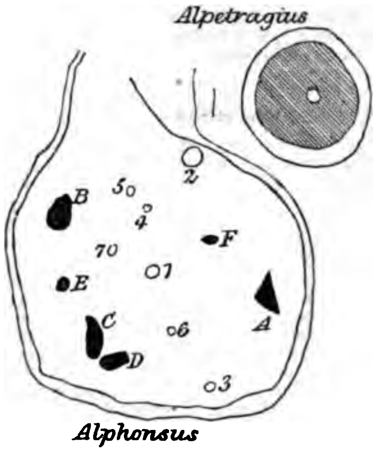
Plato.—The markings indicating the crater-cones can hardly be seen.

After reading Mr. Elger's letter concerning Fracastorius, and examining his beautiful drawing (which makes the "E. M." which contains it quite an artistic treat*), I made up my mind to look at this formation on the first opportunity. On the 18th, about 14h., I found one. Moon's age 19d. 2h. Terminator through Römer and a little W. of Fracastorius. The air was pretty clear, but the definition was very unsteady. Had it been steadier I have no doubt that I would have seen more detail; as it was, a great deal of that shown in Mr. Elger's drawing was visible with the 3¼in., and a power of 145. Of the objects designated by M. Gaudibert by the certainly appropriate, and as certainly infelicitous, name of "swellings," *p* and *y* were distinctly seen. But south-west from *p*, under the S.E. side of the wall of the formation, a rising-ground seemed to trend. Out of this rising ground an object which seemed to be p^1 appeared to rise as an eminence. The existence of an elevated surface here was plain, though none is shown in Mr. Elger's drawing. It stretched from the S.W. edge of *p*, and narrowed until it came to a point, and ended just east of the place of the craterlet shown by Mr. Elger upon the W. wall. An object occupying the place of *c* was visible, and was distinctly the brightest object on the floor. W, the object midway between it and *a*, and the ridge S.W. of it were easy. S.E. of the latter were seen two parallel objects running S.W.—N.E., and casting shadows. The heart-shaped mountain *b* was visible. Westward from, and parallel with, the southern spur from the E. wall, ran a spur not shown in Mr. Elger's drawing. West of this lay what appeared to be a deep, elongated, crateriform object.

In the remarks on Jupiter upon p. 240 (letter 22036), there is a mistake in punctuation, perhaps due to myself, which alters the sense. I *meant* to say that the brilliant equatorial spot was roughly circular all round *except* on the following side—where it was not quite so; but have said the reverse. I speak in the place referred to of a projection northward from the S. equatorial belt, as being distinctly the darkest marking visible. On the 28th of October I got, for a short time, an excellent view of Jupiter. The projection referred to was then so dark as to present the appearance of a dark spot. *Preceding* it, appeared a second bright spot, not, however, so bright as that *following*. A *lane* of light crossed the N. equatorial belt, running from the spot *p*, and was a curious and interesting feature. While I was observing, the eclipse of I. took place. It was rapid, but not instantaneous. The satellite seemed to me of a dull bluish-green or greenish-blue, and this hue seemed to become plainer during immersion. The satellite seemed to brighter slightly just before disappearance. This, as it appears to be, hurried extinction of a heavenly body is a startling and rather a weird sight, at least, when witnessed when not being watched for. IV. was much the brightest. III. was a little brighter than I.; and I. a little before II. IV. appeared to be white, and II. I thought bluish; III. was distinctly reddish. On the 16th, about 15h. 30m., I observed the bright spot again. It was distinctly the brightest portion of disc. The projection was not so large, but a point upon it was certainly the darkest point upon the disc. I did not see the *p* bright spot. Definition, however, was not good. IV. was much brighter than III.; III. was reddish-yellow, or yellowish-red.

Alphonsus.—In his description of this crater, Webb says, "Under a high light two bright specks, and several defined blackish patches, vary the surface, in those places perfectly level. Lohrmann drew 6 dark spots; Schmidt found but 3 dark and 1 faint." On the 17th instant, about 14 hours, I observed this formation. 3¼in.; e.p. 145. Definition not specially good. I inclose a sketch, in which are marked 7 bright and 6 dark markings. The bright spots are *numbered*, in order of brightness; and the dark spots *lettered*, in order of distinction. F was visible only by glimpses; E was plain and steady; C and D were certainly distinct. Spot 2 was larger than spot 1, and gave perhaps more light; but it was diffuse, and its outline not very well defined, while 1 was steady and sharp. A and B are marked on Webb's map. I would like much to know how the spots are marked in Lohrmann's map.

The appearance of the comparative drawings of Saturn by Mr. Franks and "F. R. A. S." may form a convenient opportunity for bringing forward a matter of some consequence. I refer to the giving of more systematic attention to the detail visible upon the *ball* of the planet. In a valuable paper upon planetary observations printed in *Nature* for October 18th, Mr. Denning remarks: "Though sketches of Jupiter are frequent enough, we rarely see attempts to delineate Saturn, and thus we have comparatively few records as to the arrangement of his belts. . . . No doubt the rings of this planet monopolise observers to such a degree that they neglect other phenomena which, though less attractive, may be of greater significance and interest." This seems to express a fact commonly overlooked, for while no astronomical phenomena *can* be, *in themselves*, of *greater* "significance and interest" than the rings of Saturn, it may well be doubted whether the representations of them which appear in ordinary sketches of the planet are in the least degree fitted to advance our knowledge of the system. What is left to learn concerning the rings of Saturn will have to be learnt either by scrutiny of them with great apertures, or by persistent observation of details, and not by the occasional drawing of their general aspect. In a letter in the *Astronomical Register* for September, the Rev. T. W. Webb takes notice of those phenomena of the system which require elucidation—such as the continuous visibility of Encke's division, the existence of minor subdivisions, the absolute blackness of Cassini's division, the shading of the brightest ring, and the phenomena of the gauze ring. But investigation upon these points, except perhaps the last, is beyond all ordinary instruments. It would be a good thing if the visibility of the gauge-ring in instruments of small aperture was made the subject of careful observation. It would be interesting to know whether any changes take place in the visibility of that portion which crosses the disc. Of course, there is nothing to prevent the disc behind being covered with a material of higher reflecting power at one time than at another, and so throwing out the ring with greater distinctness at such times. Any inquiries as to variability are, of course, always attended with the uncertainty due to the state of the weather and of the eye, and it would be well if, when any object is either unusually easy or unusually difficult, observers could always make observations as to the visibility of other faint and difficult objects. More care and caution, with less anxiety to see marvels, would no doubt reduce the number of extraordinary observations. It is, however, to the phenomena of the belts, zones, and spots upon the ball that I would direct attention. I do not, of course, know whether the engraver has *exactly* reproduced the drawing made by "F. R. A. S.," but if he has, it strikes me as curious and interesting that a 4½in. should not have shown detail revealed by my 3¼in. The difference is this: in the drawing by "F.R.A.S." the entire southern hemisphere is shown as almost *equally* shaded, and without subdivision into belts or zones of any kind; but on several occasions lately I have distinctly seen, when definition was good, at least two dark belts. Now, we know that the belts have been seen with 2in. of aperture. The only explanations of these discrepancies are these: the belts may be variable in distinctness, they may be variable in form and persistence, or they may be more readily visible upon one portion of the planet than upon another. Upon the first hypothesis it would be necessary to assume that the material of the belts varies in light-reflecting power—a point worth investigation. The second is the most probable; but unless we can unite with it one of the others, we are driven to suppose that the surface of the planet changes with a rapidity for which we are not altogether prepared. Of course, it is quite possible that clouds may be deposited and dissipated with great rapidity in the higher regions, above the locality of the belts. If these phenomena took place, we would, of course, at times not be able to see the details of the belts. The third hypothesis suggests an interesting possibility. Of course, though it *should* be proved that the belts are apparently discontinuous, or in some other way different in different parts, it would still remain possible that the apparent variations were due to obscurations by clouds formed as suggested above. But one thing is clear: to settle such a point we must compare sketches according to the period of the planet's rotation to which they relate. The period of axial rotation of Saturn is brief, and not commensurable with that of the earth; consequently, if we inspect the planet at about the same hour each night, we must inspect on each occasion a fresh part of its surface, and if we vary our times of observation we must still very probably do the same thing. Therefore, not only ought all sketches of the planet to be carefully dated, but we ought, in comparing one sketch with another, to take care that we notice whether we are comparing representations of the same, or of different, portions of the discs. The hypothesis which suggests *change* is the most interesting, and it would be all the more interesting were there any suspicion of *periodicity* in the changes. In describing the planet, Mr. Webb says: "The globe is diversified by darker and lighter bands, changeable, but usually parallel to the equator, though Sir William Herschel noticed occasional deviation. His 'quintuple belt' of alternate light and shade is now seldom to be seen; usually there is a strong central whitish band, the brightest part of the ball; on each side of it a broad brown or somewhat ruddy zone, with many streaks and markings, generally parallel, and, according to some authorities, reaching to the limb; to the principal of which the Washington achromatic gives wavy edges: then a similar greenish or bluish grey region extending to the poles, which are capped by a darker patch of the same tint, with sometimes a pale central space. Sir W. Herschel found the brightness of the polar regions variable. Browning describes the colours in 1868, with a 12½in. mirror, as light cinnamon and bright azure blue." To find in how far this description holds good *at present*, and to discover what changes, if any, make themselves visible from time to time, would be excellent objects for possessors of telescopes to place before themselves. It would be very interesting to know what change, if any, takes place in the *colours* visible upon the ball. Of course, this latter inquiry could only be conducted with instruments of considerable aperture, and preferably with reflectors; but there are plenty such lying idle. It will be seen that it is the making and comparing of drawings of the ball, care being taken to record carefully the times at which the drawings are made, that I urge; and if the sketches are made, I would suggest that some, at least, should be published. Inasmuch, however, as a sketch of Saturn takes up a considerable amount of space, and you, Sir, might object to give up so much to the subject, I would suggest that the sketches when published should be limited to the ball. Representations of the ball alone would not take up so much space, and would not cost so much to engrave as representations of the entire planet. I would especially like to see, and I am sure all your astronomical readers will agree with me, sketches by Messrs. Webb, Denning, Franks, Perry, Williams, Bruce, and Barnard.



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* The credit is entirely due to Mr. Elger, and correspondents who complain of the bad reproductions of their sketches may take a hint.—Ed. E.M.

The subject is one of great interest and importance; at present the planet is well situated for observation. I do hope to induce some of the numerous owners of large telescopes to attack the problems involved. Cannot the able and energetic heads of the Liverpool Astronomical Society do something in the way of setting amateurs to work at the elucidation of these matters? Certain points seem to me worthy of special attention. First. The occurrence of belts lying oblique to the planet's equator. These seem to be very rare. One is shown in a sketch in the E. M. by Mr. [illegible], taken with [illegible]in. [illegible] October, 1877, but it is comparatively small. Second. The character of the belts. They are generally represented as equal and continuous. That they are, perhaps, not always so is, of course, one of the points raised above. In Mr. G. F. Chambers' "Descriptive Astronomy" there is a drawing by Bond in which the markings on the disc are shown in a way utterly different from that in which they are usually shown. In this, not only are the belts discontinuous, but their ends and [illegible] are [illegible]. The possible discontinuity, [illegible], and variability in brightness, [illegible], and colour, of the various belts are all matters well worthy of investigation by those who have telescopes which will carry them through the work.

In this connection, a point relating to the notes and drawings of Saturn furnished in these columns may be mentioned. In the drawing by [illegible] we find the northern edge of the shaded portion of the S. hemisphere rather more [illegible] than the rest. In Mr. [illegible] drawing we find the corresponding border [illegible] with the best definition —a [illegible] circumstance, if the engravings are [illegible] on these points. In neither case have we [illegible] suggested. But in letter [illegible] p. [illegible] Mr. [illegible] says "The wavy edge of the [illegible] of the bright equatorial belt was well seen." This I take it comes to the same thing as [illegible] of the dark equatorial belt already referred to. [illegible] Mr. Perkins' [illegible] Mr. Franks [illegible] the boundary of the dark belt and the bright zone [illegible]. The recurrence of spots, [illegible] says "Spots and streaks [illegible] easily enume- [illegible] observers to keep [illegible] they come they do not [illegible] observations of spots on [illegible] they would throw [illegible] of the planet [illegible] within it and they [illegible] of the [illegible] planet's [illegible] about Saturn. I [illegible] between [illegible] that for [illegible] between the ring and [illegible] a star [illegible] between the planet [illegible] Taurus [illegible] Sagittarius in [illegible] the new [illegible] however, that [illegible] of the [illegible] He remarks [illegible] unfavourable [illegible] certainly [illegible] occurrence of [illegible] of estimation [illegible] different parts of [illegible] with [illegible] but proper [illegible] of their [illegible] not fail to be [illegible]

[illegible] Baird Gemmill.

MÄDLER—THEOPHILUS—HORROX—FRACASTORIUS.

[illegible] I first observed [illegible] I was not [illegible] what it was; but in 1880—Feb. 28th and March 17th—with a 4in. telescope, I saw it plainly to be a crater, and marked its position at the south-western end of Mr. Neison's short ridges. This corresponds with Mr. Gaudibert's position. I thought that it was nearer to Mädler than to Theophilus. I have seen it since that time, once in 1881, and three times in the present year. April 25th of this year is the only occasion on which I noted it as a *white* crater. In 1880, March 17th, and 1883, Oct. 20th, there was a second crater W of it. On these and other occasions a ridge was seen W. of both craters, springing from the N. wall of Mädler and bending to the east, partially inclosing the ground on which the craters are situated. Some small hills are also to be seen on this ground. Neither the ridge nor craters are shown by Mr. Neison. Two craters N. of Theophilus, which are shown by him, were also seen on the two dates in 1880 above mentioned.

I have been watching for the crater in Horrox. At the last moon the weather was unfavourable. On the 7th of this month at 4h. 30m. p.m., though there was not much shadow remaining in Horrox, it was sufficient to hide the crater; the shadow bulged out on the floor, however, at this point. By 8h.30m. the shadows had considerably lessened under the wall S. of the crater, while there it was a large round, dense patch exactly like a hole without walls. Clouds prevented anything more than this momentary glimpse. The next night also, the moon was not to be seen even for a moment.

I thank Mr. Elger for his reply about the rings N. of Fracastorius. I have many sketches of them, in all of which they appear perfect: but this is no doubt owing to my having used a smaller telescope. Only on one occasion did I note that the ring A was broken. The ridge which Mr. Gaudibert mentions as inclosing B, C and D, I have also seen; a sketch of Fracastorius in the *Selenographical Journal* by Dr. Richards also contains it. Y has generally appeared to me as a dark patch very similar to N; but it is much more rarely visible, while N, with one crater in it, and A with one crater, are very generally to be seen. The cleft ρ^1 must, I think, be rather easy to see sometimes, for I saw it in 1878 with a 3¼in. telescope, when I had not observed Fracastorius before.

M.A.

SELENOGRAPHICAL—FRACASTORIUS.

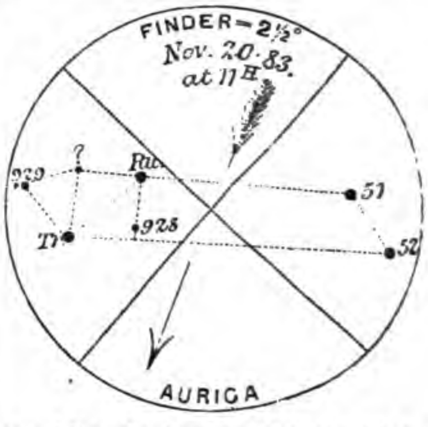
[22123.]—In reply to Mr. Gaudibert (letter 22093), allow me, in the first place, to assure him how highly I appreciate the very complimentary remarks he makes regarding my drawing of this formation, which, emanating from so diligent an observer as himself, are of more than ordinary value. With respect to the principal cleft shown in his sketch (English Mechanic, Vol. XXIII., p. 495), the want of agreement as regards position and direction between the western portion of it as there depicted, and my cleft ρ can perhaps only be accounted for on the not improbable supposition that they are two distinct features. September 20th was not the only occasion on which I have been favoured with a satisfactory view of this cleft. On referring to my observatory book I find, under date 24th January, 1882, 5h. to 6h., that it is shown almost precisely as in my recent drawing, and is noted as "an undoubted cleft traceable from the west side of *a* to a crater cone not far removed from the foot of the inner slope of the west wall." On the same evening another short and delicate cleft was observed south of ρ (and distinct from it), making an angle of about 45° with it, and trending in a S.W. direction. I note with very great interest the cleft shown in Mr. Gaudibert's drawing on p. 302, crossing the semicircular formation A, and terminating on the south at the craterlet 41. The latter, by the way, is double, the component craterlets lying in the direction of the cleft. I usually find the peaks on the low narrow ridge which extends from A to the eastern wall, very easy objects under a low sun. This ridge seems to be made up of three distinct portions, as clearly shown in Mr. Gaudibert's sketch. On October 1st and 2nd, 1870, with a power of 200 on a 4in. achromatic by Cooke, I saw these peaks very plainly, and describe them as "bright and conspicuous." The floor of Fracastorius falls rapidly towards the S.W. side of this ridge, thereby forming a deep ravine or wide valley, which runs parallel to it throughout its length. The "fine ridge," *m*, has been frequently observed, though on the date of my drawing not a trace of it could be distinguished. It is of so moderate a height that I cannot see that it affects the question as to the possible incursion of the Mare from the north towards the objects B, C, and D. On January 24th, 1882, three large craterlets were observed on the outer slope of the E. wall of Fracastorius, the most southerly of which seems to agree in position with Mr. Gaudibert's *e*; the remaining two were more to the north. The two minute craterlets shown in my drawing immediately north of *f* are distinct from the craterlet 47, which I generally find an easy object, though it was not seen on September 20th. I should like to say a word or two respecting the object numbered 18 by Mr. Gaudibert, and lettered C in my drawing. Under a high sun, it has the appearance of a large round nebulous spot, with an ill-defined outline; while under very oblique illumination it accords perfectly with Birt's description, "A round-topped tableland." Schmidt shows a *large* crater here; and Grover, on 1st July, 1865, records it as a crater. But my experience of this object, extending over some 15 years, induces me to regard it as very difficult to make out as a craterlet. On 24th January, 1882, with a power of 350 on my 8½in. mirror, it appeared to be surrounded by a peculiar nebulous light or glow, very different from the tone of other spots on the floor; and it was only after careful and sustained attention, that I could just detect in the midst of the brightness a delicate craterlet of the minutest type, which would certainly not have been distinguished had not the definition been exceptionally good—so good, in fact, that 29 craterlets were, more or less, easily seen in the interior of Fracastorius, without taking into account isolated mounds or craterlets visible on and about the north border. The extreme difficulty of seeing 18 as a craterlet seems so inconsistent with Schmidt's representation of it as a large crater, and Grover's observation of it with, I believe, an achromatic of very moderate aperture, that I shall be glad to learn from Mr. Gaudibert or other observers whether my experience with respect to this object is peculiar or not.

Thos. Gwyn Elger.

Kempston, Beds, Dec. 8th.

AURIGA.

[22124.]—The following note may perhaps have an interest to some of your astronomical readers. There exists in Auriga a quartette of objects very near together, and each of them I think will be allowed a tolerably good specimen of its class. There is a red star, a tolerable close double, a pretty triple, and another double, with a charming greenish *comes*. All these may be seen together, with the least turn of the screw, in the field of 60, on a 3in. ach. I observe them with this power in a first-class 3in. Wray, and really the view is one of great interest, and, so far as I know, not to be met with elsewhere. The positions and details of these objects are given in Prebendary Webb's invaluable "Celestial Objects." May I beg the favour of your insertion of the accompanying sketch, if you can find room?



51 and 52 Aurigæ (see Proctor's Large Atlas) are roughly, 8° below β and θ Aurig., but a little nearer θ. Without any very mathematical exactness, I may describe the principal stars 52, 51, Ru., and Tr., as forming the half of a hexagon. These four stars are prominent in the finder, and stretch pretty well across its field. Having secured this half-hexagon, the other stars are easily identified—*e.g.*, 928 is at a right angle to Ru. and the Triple, and 929 is on the left of, and forms a triangle with, Ru., and the Triple. The *comes* of 929 is a charming object.

Whilst writing I may add that 51 and 52 point twice their distance to 941, which is below them on their right, but is not shown in the sketch. I think 941 a good test for a 3in. ach. It has also what I think is a good light test in a very faint comes, perhaps 80 *s.f.*

If you can find room for the following details, it will help to the clearness and completion of my communication.

AURIGA.

	Mag.	P. A.	Dist.
Ru.		Distinctly so.	
928	7, 8	134°	3·4
Triple	6¼, 8½, 9	—	—
929	7, 8	24°	6
941	7, 8	77°	1·2

Dec. 3. **H. D.**

SATURN.

[22125.]—I took advantage of what appeared to be a tolerably favourable evening on Wednesday last, the 28th ult., to compare the figure of Saturn given by your correspondent "F.R.A.S.," on page 263 with the planet itself, and it may perhaps interest some of your readers to learn what can be done in the neighbourhood of London with an achromatic of exactly the same aperture as that used by "F.R.A.S." All the features of the figure were at once seen without any effort whatever, and, except that the bands across the planet were somewhat different, everything appeared very much as there represented, even to the shade on the outer ring, which though not so dark as in the figure, was more apparent than I ever recollect to have noticed it. The division in the ring, however, appeared wider in the ansæ than given by "F.R.A.S.," and I thought it appeared better defined on the inner edge. With a power of 260, the great difference between the light of the two rings, together with the termination of the shadow of the planet at the outer edge of the inner ring, gave the idea that they were not in the same plane, the inner ring appearing to be raised above the other. With a power of 140, the difference in light was not so apparent, and with 100, no difference could be perceived. The dusky ring was very indistinct, and of a bluish-grey colour, and only the half of it nearest the earth could be made out. I do not know whether this is intended to be represented in the figure of "F.R.A.S."; but it is rather remarkable that the other portion could not be seen, for Hind in his "Solar System," p. 110, says:—"The more distant portion of the new ring is seen much more distinctly than the corresponding portion nearest the earth." Perhaps some of your correspondents who have larger apertures will give us their experience. Five satellites were visible with powers of 260, 140, 100, and a lower power—I think about 60 or 70. They were perhaps brightest with the lowest power; but the whole system was of course very much reduced, and two of them were brought very near the outer edge of the ring. They were seen easily with all the eyepieces.

At 10·35 a brilliant white fireball became visible between Xi and Eta Draconis at about a third of their distance from the former star, and made a direct course towards the horizon, leaving in its wake a train of small sparks. It vanished about 15° above the horizon. **Henry T. Vivian.**

SPECIALISM IN ASTRONOMY—CHINESE WHITE—SATURN.

[22126.]—The remarks of Mr. Maitland Baird Gemmill (on p. 239), on the advantage of not working only at one branch, are certainly true; but the difficulty is that if we would do good work at any branch, we must concentrate ourselves upon it, and the nights and days are too short to concentrate ourselves on much more than one branch. My own experience is this: last winter I worked at three branches, with the result that for four or five months I was up, for several days together, 22 or 23 hours out of the 24, then getting three or four hours sleep for a night or two when it was cloudy, then only one or two hours again.

Through the summer I have worked at two branches. The short nights gave me more sleep: but then and now I often do not go to bed for fifteen nights together, sleeping between times as I can. This is the result of working at more than one branch. I suppose every one has not time to sleep in the day. I have not.

Mr. Franks and "F.R.A.S." have observed that Saturn bears a higher power than Jupiter. Have they also noticed that the focus for it is different to that for Jupiter? I have always observed this to be the case.

A short time back some one stated, in reply to a query, that glycerine should be put to Chinese white to soften it. I did so with mine, with the result that I have spoiled three elaborate drawings. It certainly softened the Chinese white; but nothing that I can do will make it dry on the drawing. I think people ought not to recommend things without knowing what they answer, unless they do it with a warning. **Brickwall.**

LIGHTNESS OF WINTER NIGHTS.

[22127.]—I have often wished to draw attention to a curious fact which I have long noticed—viz., the brightness of the nights sometimes when the moon is not above the horizon, and there is nothing to account for it. It happens on both cloudy and clear nights, and the light being sufficient to make out the various things in the observatory; and out of doors it is a strange contrast to the intense darkness of some other winter nights. The amount of light is generally greater on cloudy than on clear nights, being then equal to what the moon sometimes gives. Perhaps it can be better explained on cloudy nights; but I can see no reason for it on clear nights. Have any other correspondents noticed it; and can anyone account for it? **M.A.**

LOCOMOTIVES.

[22128.]—Mr. Wm. John Grey (page 305) expresses "*surprise*" *that I have not written a reply* upon this subject. He is, perhaps, unaware that in back volumes of the English Mechanic I have discussed the question very fully, and given the necessary formulæ. In my opinion, the information for which Mr. Grey asked has been fully and ably furnished by Mr. A. Luis and "Historian." The rules for resistance and tractive force have been clearly and correctly given by both these gentlemen. I am at all times happy to give assistance; but I really cannot see any useful object in taking up valuable space simply to repeat rules which have already been furnished by two correspondents. **Clement E. Stretton.**

Glen Magna, Dec. 8th.

CONTINUOUS BRAKES.

[22129.]—"Imprimatur," in letter 21991, makes a statement that air brakes cannot be used for shunting purposes. "Imprimatur" evidently knows little of the Westinghouse brake. I see it used every day for shunting purposes. Before the coach to be shunted is detached from the train, the taps at the end are closed, the reservoirs being charged with air. A man riding on the step can open the tap when required, and the brakes are applied with full force. I see coaches on the N.E.R. running at a considerable speed stopped in two or three yards by this means.

Again, "Imprimatur" seems to forget that with the Westinghouse brake there are gauges in the vans, which the guard sees before the train starts; so that, if the cocks have not been opened, the omission is at once rectified. On the North-Eastern Railway no train is allowed to start until the guards have looked at the gauges and tested the brake.

I repeat, with Mr. Stretton, that there is always a danger of the brake connections freezing in winter, in the case of mechanical brakes. Take the case of Fay's brake on the L. and Y.R., which I have known to freeze several times. In the case of this brake (applied by the guard), the connection is a rod, which turns in a socket. This is used in the case of every stop made, and one would think that there was no chance of it being frozen, owing to the frequency of use. The chain brake (L. and N.W.R.) is often frozen. Mechanical connections are also often clogged up with dirt in nasty weather. This has also proved a source of failure in the case of Fay's and the chain brakes.

In the Westinghouse brake, very little dirt, if any, enters the pipes, owing to the use of a drip-cup for drainage. Such dirt, &c., as enters is often blown out again by the compressed air.

Simplicity is all very well, *provided*, as "Imprimatur" himself says, *the efficiency is secured*. As a matter of fact, in the case of the existing brakes, the brakes (e.g., Smith's vacuum) which fail most are the most simple. This looks well for "simplicity," though this is the point on which the arguments of the upholders of the vacuum brake are based.

"Imprimatur," and also your correspondent "Traffic" (letter 22060), seem to consider that the best plan is to use the momentum of the train to create the power by which that momentum is to be destroyed. This looks well theoretically, and may have arguments in favour of it. But let us take a practical illustration—viz., the G.W.R. vacuum brake. The vacuum is maintained on this line by a pump worked *mechanically* from the cross-head of the engine. Thus the amount of stopping power stored up in the train is proportional to the velocity; and it would seem that the brake was practically perfect owing to this system. But let "Imprimatur" look at what Col. Rich says in his report on the Portskewet Pier accident. (This I quoted on p. 85, Vol. XXXVII.) Most engineers would prefer a constant brake power of, say, 30,000lb. per carriage to a power varying from 0 upwards with the speed of the train.

Otherwise the letter by "Traffic" (22060, page 265) is very good. It would be interesting to know how the inconveniences stated by him are got over.

I must thank Mr. Parker-Smith for the interesting description of his brake.

To answer "Imprimatur's" letter, page 265. He lumps together all the "failures" (so-called) of brakes, irrespective of their nature. A train running into the buffer-stops and injuring the passengers counts just the same (according to "Imprimatur") as a few minutes' delay, the latter possibly arising from the negligence of a servant. But let "Imprimatur" give us a list of failures under headings 1, 2, and 3 of the Board of Trade, and the difference will be strikingly shown.

Let us look at "Imprimatur's" figures. He gives 16 as the number of failures of the Midland Clayton Automatic Brake. I have before me a record of considerably more failures of this brake, many of which were not reported.

The Midland Railway report 29 failures of the Westinghouse brake. I may say that this brake is scarcely looked after at all on the Midland, and a great fuss is made when it (naturally) fails, even when the failure is a few minutes' delay. On the other hand, great care is taken to keep quiet about the vacuum brake failures, and the drivers scarcely dare risk their position by reporting anything against it. Engine 814 has just come out of the shops, and the Westinghouse donkey-pump looks as if it had scarcely been seen to, and the air-pump formerly on engine 902 was in a shameful condition for several years. No wonder this brake fails on the Midland Railway. "Imprimatur" says that Clark and Webb's chain brake shows very satisfactory results. "Imprimatur" has peculiar ideas of "satisfactory." The L. and N.W.R. Company are removing this brake because they find it unsatisfactory. The brake is only an emergency brake, and is rarely used. I have heard several drivers say that they would far rather rely upon the hand brake.

Of the Smith's vacuum brake little need be said. Most of your readers know that it is unreliable. Taking the Board of Trade returns from 1878 to 1881 inclusive—

Number of cases of overrunning owing to failure of brake itself: Westinghouse 9, Smith's vacuum 216; other cases where stopping power was affected owing to brake itself: Westinghouse 7, Smith's vacuum 340.

In the above 556 cases of failure of Smith's vacuum brake, there are 5 accidents due to the failure of the brake, or which the brake proved useless to prevent. Five *other* accidents reported on by the Board of Trade inspector were *not* included.

"Imprimatur" shows a great deal of inconsistency in his arguments. From them it seems that he argues *in favour of* automatic brakes when advocating the cause of the Parker-Smith brake, and *against* them when he has a fling at the Westinghouse. For instance, he makes a great deal of the point that automatic brakes (of course, only the Westinghouse) go on unexpectedly and stop the train, and possibly another train runs into the first from behind. He seems to forget that the Parker-Smith brake is also automatic, and the same thing is also liable to occur. He does not seem to think it better for the brake to show automatically that there is a defect somewhere; but he prefers the train to run on until, when the brake is required, it is found, when too late, that there is none. He claims for the Parker-Smith brake that it is automatic. If it did this sort of thing, I should like to see what "Imprimatur" would say. Again, in support of his statements, he records a failure of the Westinghouse on Long Island Railroad, U.S. Before "Imprimatur" records failures he had better make sure of correctness. The brake failure in question was one of Smith's Vacuum Brakes. This is the brake in use upon this line, and the Westinghouse is not employed at all. I never heard of the St. Alban's case. Will "Imprimatur" give full particulars instead of the vague uncertain statement in his former letter? It is all very well to make a long argument because the Westinghouse stops trains automatically, thereby endangering it. Let us look into the case.

The Brighton Railway Co. ascertained the number of stops made upon their line on two separate days. On 5th April, 1883, 16,460 stoppages; on 26th July, 1883, 17,747 stoppages. Of these, about 7,000 on each day were extra stops (signals, &c.). Therefore, "Imprimatur's" one great argument entirely breaks down, as here were 7,000 cases of trains "endangered" by unexpected stops. **Meteor**

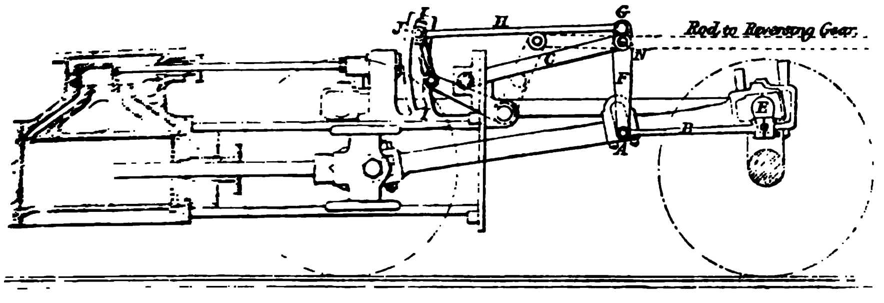
THE MORTON VALVE GEAR.

[22130.]—On page 411 of last volume, I gave a diagram and description of Joy's valve gear, I now send similar details of Morton's gear to which a correspondent (p. 273) refers.

The inventor read a paper before the "Institution of Engineers and Shipbuilders in Scotland" about a year ago, and since that time the practical working of the gear confirms all he said in its favour. It will be seen from the accompanying copy of Mr. Morton's diagram, that the motion of the connecting-rod of an eccentric or overhung crank, are combined and communicated through levers and radius-rods to a curved link attached rigidly to the valve-rod, and sliding in a suitable guide, the motion of which is given by the rod attached to a pin in the die of the link; the reversing and expansion depends upon the position of the die in the link.

Your readers are aware that a fixed point on the line of a connecting rod, actuating a crank describes the path of an irregular elliptical figure resembling the outline of an egg, the larger end being nearest the crank, so that any lateral motion derived therefrom must be irregular. This difficulty is not a new one, as it has presented itself to every engineer who desired to obtain valve motion from a point in the connecting rod.

To overcome this source of error, it will be seen that Mr. Morton adopts a simple means to convert the irregular lateral motion into a regular motion. The movable point (A) is actuated by an overhung crank (E), through the link (B); the link (C) vibrates and carries the fulcrum (N) of the lever (F) through its circular arc, but the lever F



[illegible] an extended over-end centre (G) so far distant from N as just to give it horizontal travel equal to amount of the "lap" and "lead" of the valve, whilst the vertical travel agrees with the minor axis of the elliptical figure described by the movement point A. The link (H) is connected at its end to the centre (G) of the lever (F), and thus follows a through the small elliptical path; the upper end is jointed to a slide block or die (J), capable of adjustment in the curved link (I).

The Morton gear is now fitted to a bogie passenger engine on the Caledonian Railway and appears to give satisfaction.

Clement E. Stretton.

[illegible]-street, Dec. 1st.

KEY CHARACTERISTICS OF MUSIC.

[illegible] by itself a key has nothing independent [illegible] other keys. It has a major and minor mode [illegible] with some others, and is affected by [illegible]. A shifting keyboard [illegible] are all alike. Play the [illegible] the only difference is [illegible] again in a minor mode and [illegible] a melancholy ditty. [illegible] obtained by suddenly [illegible] part, half a tone [illegible] gradually returning to [illegible] the "Bohemian [illegible] would be pro- [illegible] A peculiar effect is [illegible] by having a slight [illegible] and out of tune. [illegible] of a violin, when [illegible] is moved from side to side. [illegible] organ, but not so [illegible] be varied to suit [illegible] all you see, [illegible]

Fiddler.

HIDDEN LIGHT.

[illegible] that I had a serious [illegible], but had a diff- [illegible]. It was the [illegible] light that I [illegible] to illustrate a [illegible] Magazine [illegible] that even [illegible] at rest, that [illegible], even though [illegible] a diamond." The [illegible] Astronomer Royal of [illegible]. Now I, in my [illegible] with those [illegible] surprised to find in [illegible] I thought all [illegible] opposite direc- [illegible] nature, viz.— [illegible] by numberless [illegible] figure. I [illegible] of wit."

Fiddler.

TRICYCLE.

[illegible] their various [illegible] say a few words in [illegible] I have ridden it now [illegible] since September [illegible] steadily, easily, and [illegible] for brickbats. [illegible] a bicycle, and that [illegible] I want to know [illegible] out of it? Being [illegible] this. For those [illegible] motion, having [illegible] and speed. The gear- [illegible] without stop- [illegible] free running, which [illegible] Its disadvantages are: [illegible] its weight is 95lb., [illegible] very glad if other [illegible] give their experience.

I would also bring before your tricyclists the pleasure of [illegible] frozen road, and particularly on a moonlight night. It is a great mistake to think that the frost stops the tricyclist's enjoyment.

John Alex. Ollard.

MICROSCOPIC TEST OBJECTS.

[22134.]—Having worked at these objects for some years, and having also kept pace with the times in objectives and apparatus, I will, in answer to Mr. Carr's request (22076), give the results of my experience. 1st, the total abolition of oblique illumination if one wishes to see the true structure of an object; 2nd, object mounted dry on cover.

I use a P. and L. achromatic condenser, accurately centred to the optic axis. The edge of the flame of a paraffin lamp, with $\frac{1}{4}$in. wick, exactly focussed on the object, without bull's-eye or mirror. This illumination, with a P. and L. oil $\frac{1}{12}$, N.A. 1·43, easily resolves A. Pellucida, dry on cover, *with direct light*—i.e., without slot or stop.

If S. gemma is examined by this means, the hemispherule theory is at once exploded, and the true structure (which is far more beautiful) is revealed. It is something like a most delicate skeleton leaf. This, however, is very difficult for a beginner. The P. formosum is, perhaps, the best one to try first. Work away at that until the hemispheres, which are so easily seen, give place to a *square* grating! To see this, with a $\frac{1}{4}$, N.A. 74, will severely test the lens and the observer's manipulative skill. A coarse Nav. lyra and a Tryblionella punctata, both have square apertures, and are very easy. N.B.—If the objective is much out of correction, the square apertures will blur round. The next one to try is P. angulatum. In this, a fracture should be distinctly seen to pass *through* the apertures. The apertures will take a *rose* tint if the glass is properly corrected.

It is manifestly absurd to test an objective by a fine diatom seen with oblique light, for only a small portion of a narrow marginal zone of the objective is used. The central, and by far the more important, part of the glass might be stopped out.

By the central illumination, however, the whole of the objective is used; the centre by the dioptric beam, the margin by the diffraction pencils. In former days one used to hear this sort of thing said: "This $\frac{1}{12}$ is a beautiful diatom glass." "This $\frac{1}{10}$ is splendid on 'Podura,' but not good at diatom resolving." (What a fine thing for the opticians! One had to buy two glasses, one for Podura and one for diatoms.) The explanation is very simple: For Podura a glass must be good in the centre, and for diatoms, with oblique light (the only light used in those days), good in the marginal zone. So then the $\frac{1}{10}$, which was good for Podura, and the $\frac{1}{12}$ for diatoms, could neither of them have been thoroughly corrected from their centres to their margins. I have a glass in my collection which is very fair on Podura when the screw collar is in one position, and also is a good diatom resolver with its collar in another position; but when all its zones are tried at *once*, by the direct illumination, it utterly breaks down.

With regard to A. pellucida, the *strongest* resolution is obtained with P. and L.'s vertical illuminator. The long striæ can only be seen by this method. Spurious long. striæ may be easily seen; but the true lines are very difficult, and may be estimated to be 120,000 to the inch at the lowest. The transverse I have counted repeatedly, and find them, in Van Heurck's specimens, very constant at 95,000 per inch. The best picture of the trans. striæ is obtained with oil imm. $\frac{1}{12}$, N.A. 1·43, or oil imm. $\frac{1}{8}$, N.A. 1·38, and P. and L.'s oil immersion condenser, *used dry*, with single slot, edge of flame direct, valve being dry on cover. The lowest angled glass, with which I have seen the trans. striæ, is a water imm. $\frac{1}{16}$, N.A. 1·08, and the lowest power $\frac{1}{4}$, N.A. 1·17.

December 4th. **Edward. M. Nelson.**

OPTICAL.

[22135.]—I regret that we are to have only the results, not the method, of Dr. Hastings, and still hope we may obtain the original. I trust, Sir, you will advertise the want as widely as possible, that some of our American friends, perhaps even Dr. Hastings himself, may be induced to let us have an outline of his analysis; the notion of "light energy" sounds well, but is somewhat Greek to most of us. I am glad Littrow's papers are coming, and shall hope to see Gauss's follow.

As regards dispersion, I would not have troubled "O. V." but that I thought his remark had some deeper meaning. Of course, a substance has as many dispersions as there are wave-lengths between red and violet—perhaps more; but fixing on the index of refraction of any one length as a standard the dispersion for light of any other wave-length is definite enough, and for their colour the ratios of dispersion of crown and flint are also definite enough, and but for the irrationality of the spectra would be very definite indeed, and the same for every pair of colours in the spectrum, till we get glasses with the colours of their spectra arranged proportionately; we only attempt to unite two colours, and which two seems a trouble. C and F, D and F, and perhaps (for three colours) C E G are mentioned in theory, because the most brilliant and most nearly complementary; but whether these are used in practice I should doubt. I should think experiment would decide the best ratio of dispersions to use for any kind of glasses more conveniently than theory; but it just strikes me that merely picking the two brightest complementary colours is perhaps inadvisable for this reason—that the ratios of dispersion for so many other colours may be alike, though not quite the same, as that for C and F, that it might be worth while to let go perfect accuracy of union of C and F in order to bring the collective weight of these others to bear on the side of achromatism.

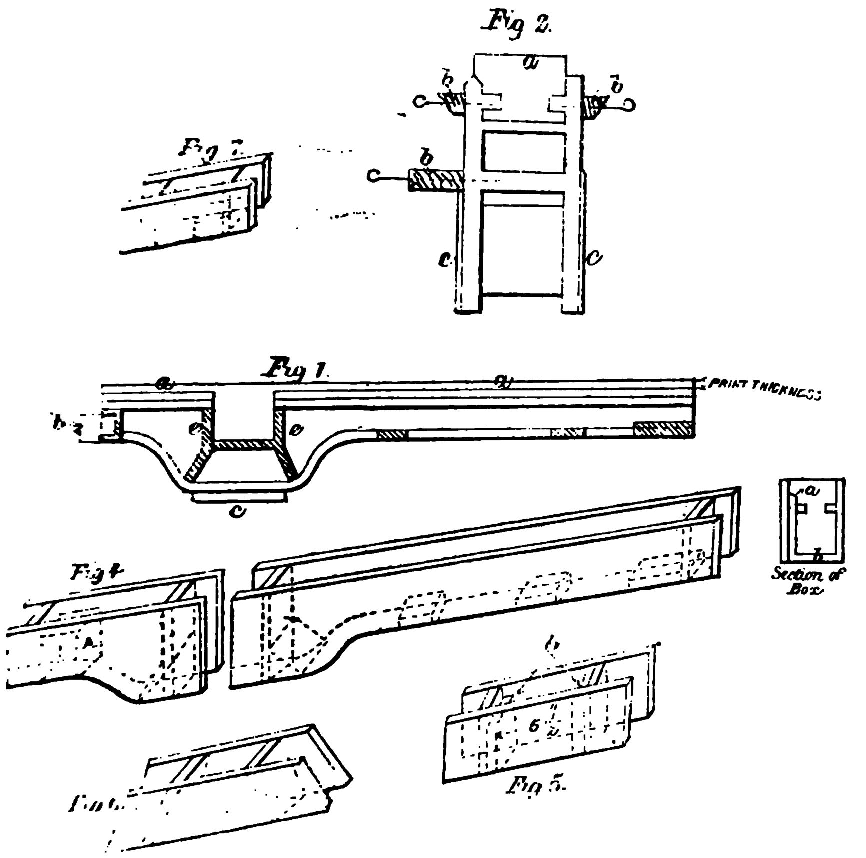
There is no book on the "Construction of the Achromatic Object-glass, in Theory and Practice," as far as I know, in any language. I beg to state my belief that one giving the pith of Coddington, Barlow, Littrow, Gauss, Herschel, and "O. V.," with the working processes of Dollond, Tulley, "Prismatique," and others, would not be of limited interest: it would be on the hobby of thousands, and we should "sell the farm to buy the horse."

Can any one give a list of papers on the working of o.g.'s by Dollond, or others since his time?

Bow.

COMPOUND ENGINES OF TWO CYLINDERS.

[22136.]—Seeing that the interest taken in compound engines is growing among your readers, I think a few words upon the variable results which may be obtained from a given quantity of steam may here not be out of place. I think few of your readers will have failed to notice the description given by some querists of their way of cutting off steam in both cylinders of their compound engines, and especially in the low-pressure. So varied are their arrangements that we find the cut-offs are arranged for one-third, one-half, and two-thirds of the stroke, regardless of the relative ratios that the cylinders bear to each other. I need scarcely say that with some of these arrangements the power of the compound will be less, theoretically, than that of a single cylinder engine using the same measurement of steam. Now, in my opinion, the cut-offs in the low-pressure cylinder of a compound engine should be constant. When I say constant I mean that the cut-off should occur when the low-pressure piston has traversed a sufficient distance for the cubic capacity within its cylinder to equal the whole cubic capacity of the high-pressure cylinder. This being so, the volume of steam contained in the high-pressure cylinder would not have to be increased, but would only have to be transferred from one into the other cylinder. Its volume not being increased, its pressure would remain the same, providing there was no loss of heat in its transmission, and, in this case, I shall suppose that no such loss does occur. If this mode of cutting off steam be adopted, the same theoretical power may be obtained with a compound as is obtained with a single cylinder engine; for I believe it has never yet been shown that a compound engine would give a higher theoretical power than a single cylinder engine with the same number of expansions, pressure, and measurement of steam; but it is easy to show a loss in the compound compared with the single, if the cut-off in the former be not properly arranged. From this I hope it will not be thought that I am opposed to the compound principle, for I am not, and I should be surprised to find anyone that is, knowing the practical advantages that it has over the simple engine. Now the greatest object of me writing this letter is to show that a fixed point of cut-off in the low-pressure cylinder is highly necessary, otherwise loss may be the result of compounding: and it has been stated that what cut-off is good for one cylinder is good for two, and this is borne out by the law of proportion given by Mr. Sutcliffe, which is, that the proportionate areas of the cylinders are to each other as the square-root of the number of expansions, and as the root is to the square so must be the cut-off in each cylinder, and I have no doubt but that this is the only proper way of obtaining the best results from the compound engine. To compare the power of a compound with that of a single-cylinder engine when a given volume of steam must only be used, I shall proceed by taking a simple engine, with a cylinder of 300 sq. in. area and a 3ft. stroke, making a piston speed of 400ft. per minute, with an initial pressure of 72lb. absolute, and a terminal [illegible]



[illegible], and the ends of the bed in the longitudinal view, Fig. [illegible], and with the plain sides in the transverse view, Fig. 4. Make a print, say ¼in. thick [illegible] continuous from end to end, [illegible] the recessed portion, and [illegible] cut underneath the gap. The [illegible] Fig. [illegible], b b b, will be wired on loosely, so that they may be drawn into the mould after the [illegible] of the pattern itself. The border or [illegible] Fig. [illegible] which you are troubled, will [illegible] for the planed faces of a [illegible] downwards, and the strips will [illegible] with brads or screws. [illegible] pattern [illegible] on the face side than on the opposite one. The rest of the work [illegible] core-box for [illegible] Fig. 7, end recess. [illegible] strips from [illegible] of lines, but [illegible] In that section the [illegible] Fig. 2, and [illegible] which may be [illegible] box. In Fig. 4, [illegible] the end recess [illegible] In Fig. 5 are shown [illegible] in this [illegible] continuous, and [illegible] from the top of [illegible] shouldered [illegible] desired to [illegible] themselves. [illegible] from one [illegible] Observe [illegible] box, that the [illegible] continued [illegible] they shall reach just [illegible] further, Fig. 7 is [illegible] that is, the core made [illegible] at the end of [illegible] with the top [illegible] that trouble. [illegible] I should say [illegible] of the film. [illegible] Half that [illegible] the work it has to [illegible] inherently [illegible] J. H.

[illegible] If this querist will [illegible], he may [illegible] early, [illegible] by the con-[illegible] the latter is to be [illegible] The power of [illegible] depends on the surface and [illegible] the quantity of [illegible] ESSAR.

[52121.]—**Scribing Block.**—I would recommend this querist to see a catalogue of engineers' tools. A scribing block is really so very common a tool, that he would find one in any toolshop; but if he cannot see one or a sketch, I will send a description.—ESSAR.

[52122.]—**Phosphor Bronze.**—I believe rolling is the best, as the metal is liable to become brittle; but no doubt the company would tell your correspondent the best method. I surmise that they issue instructions for working this really valuable alloy.—ESSAR.

[52126.]—**Microscopical.**—I think the question of the best camera lucida is one purely of personal taste. There are three illustrated in the last volume; but Mr. Limont would find a collection at any of the dealers who advertise in your columns. —F. R. M.

[52131.]—**Boiler Query.**—No reliable method of calculating the strength of such a boiler. Fill it with water, as much as it will hold, and load the valve to four times what you would like to work at. Then light the fire, and if the valve lifts without the boiler showing signs of strain or leak, you may safely work at one-fourth of the pressure indicated by the weight on the valve. The rationale of this is, that water expands as it heats, and there is no risk in the experiment. A pound pressure is a pound, 16oz., or whatever you may please to call it.—ESSAR.

[52136.]—**Galvanising Wrought Iron.**—There is nothing to do but to clean the iron thoroughly, and pass through the bath of zinc. The dipping in water is to cool the zinc, if anything. GALVANOPLAST.

[52137.]—**Electro-Magnet.**—Perhaps the bell is not really louder, although two inches larger in diameter.—E. G. M.

[52145.]—**Springs.**—Simple coiled springs would be best. You can see them in the music-turning machines, which your instrument seems to resemble.—S. M.

[52147.]—**Chilled Roll Turning.**—This query is incomprehensible. What is it Mr. Wilkinson wishes to know? As query reads, one can only say it depends on the gauge.—MECHANIC.

[52149.]—**Cotton Spinning Spindles.**—Some are made of Bessemer steel, and would probably not be of much use for chisels and drills. Still, the only way is to try: but see that you get hold of a real tool-smith who understands his business, and is not above trying another method because the first failed.—ESSAR.

[52151.]—**Ammonia and Alcohol as Sources of Motive Power.**—There is an ammonia engine (Dr. Lamm's) at work, I believe; at any rate, your correspondent will find full information in back volumes. Ammonia, ether, alcohol, bisulphide of carbon are objected to, because they are so liable to leak, and so very unpleasant when they do. Ammonia and ether are both used for ice machines. ESSAR.

[52154.]—**The Ross Battery.**—If querists would but look up their back numbers, they would find many questions answered. For instance, the Ross cell was described on p. 260, Vol. XXXVII.; but surely, it was described in Lord Bury's article—or did his lordship fail to give this most important information? If so, why? Let those interested answer the question for themselves. A fuller account of the Ross cell, apparently an earlier patent, will be found on p. 492, Vol. XXXV.: but I see, from a recent announcement, that it is claimed to give a horse-power for every three-quarters of a pound of cast spelter per hour, the price of which is said to be under twopence a pound. It is also claimed that the zinc is recovered in the form of a solid oxychloride, which is said to be a valuable product because it forms an ingredient of a new insulating material. Of the other cell I know nothing, except that it is a carbon-zinc excited by "oxidone;" but if the querist will look through articles and notes on batteries, he will, no doubt, find something about it. It seems to be a modification of the Holmes patent. About new batteries, just now, it is as well to believe nothing at all without trial.—NUN. DOR.

[52157.]—**Legal.**—I think the lawyer who could answer this question as it appears would deserve rather more than 6s. 8d.—THE OWL.

[52159.]—**Speed of Dash Wheel.**—This is purely a matter for experiment.—J. C.

[52161.]—**Spectacles.**—All short-sight spectacles make type appear smaller. It is useless to appeal to opticians, as they, none of them, seem to know much about the matter, and even the published writings of experts are contradictory. My advice is, Go to the stores, select a pair of specs that suit, and don't trouble yourself about the bogey stories.—VIDEO.

[52164.]—**Leather versus American Cloth.**—The statement is nonsense; but as you wish to re-cover, use indiarubber cloth of good quality. Or if you must have leather, you will probably get a suitable skin at a shop where bookbinder's materials are sold.—B. T. K.

[52166.]—**Engine Power.**—It seems a strange thing that no two of the correspondents of the "E. M." agree as to the h.p. of "C. C.'s" engine. According to "Firer" the initial pressure is 65lb. ("C. C." states the boiler pressure to be 50lb.), and the average pressure when cut of at half to be 52lb. I had an idea that the average pressure was less than the boiler pressure; according to "Firer" it is higher: how does he explain this? No wonder he gets a higher power. "Sabata" supposes that the steam loses 10lb. pressure in passing from the boiler to the engine: it is only in a very bad arrangement that such a terrible loss as this could occur. Doubtless in "C. C.'s" engine the pressure in the engine is very nearly the same as that in the boiler. I think the following figures are correct:—

When cut off at ½ h.p. = 16·93
" " [illegible] " = 18·30
" " [illegible] " = 14·69

When the steam is admitted till end of stroke h.p. = 20·01. These figures give only the theoretical power; the actual power is what remains after subtracting the back-pressure, friction, etc. If "C. C." has a friend to indicate his engine, his friend can instruct him better than I can, being able to see the engine. A hole will have to be drilled in either of the cylinder covers, and a screw thread cut in it, into which to screw the steam pipe of the indicator. There will also be required some arrangement for producing a reduced copy of the stroke of the piston; this may be done by a lever about 40in. long, one end fixed on a centre, and the other end attached to the crosshead of the piston. The cord of the indicator is attached to this lever at a suitable distance from the fixed centre. If "C. C." has an indicator card taken, I should very much like to know the result.—GOSSAX.

[52175.]—**Perspective of an Interior.**—It would appear from "Murano's" remarks at page 308, that his actual case is somewhat different from that treated by me at page 270; but I think if he will work out, on a large scale, and study the solution I gave, he should be able to apply the methods to his own case. If, by "point of disappearance" he means vanishing point, he should remember that there are often two or more such points in a perspective picture. If he means the point of sight in a picture—that is, the point directly opposite to which the eye must be put to view the picture—then, as I formerly stated, that point should always be in the middle vertical line. If he wishes the point of sight P, to be on the north wall, he must, in the preparatory plan (Fig. 2) draw a line (X N, for example) through the station point X, and the point he wishes in D H. Next, draw a line at right angles to X N, [illegible] present the picture plane instead of the line V L in my figures. Then place the plan with this new picture line in a vertical position, draw a new line G G at right angles to it to form the base line for the new elevation instead of Fig. 1, and proceed to make the elevation corresponding to Fig. 2 as in its changed position. The perspective drawing can then be deduced from the new Figs. 1 and 2, in the manner previously explained by me. As regards the shape of the ceiling, I understood "Murano" to say at first, that it was not like a tunnel: but now it appears that it is like a tunnel except near each end. To show on my Fig. 3, what I now understand to be the form of the ceiling near the north end, all that is necessary is with a line joining H and E as major axis, to describe a semi-ellipse of the same proportions as N A S in Fig. 1; then the part between H and the point of the semi-ellipse cut by the hyperbola N A, will be the junction line of the north and west parts of the ceiling, whilst the junction line of the north and east parts will be part of an ellipse of which a line joining D W is an oblique diameter, and which can be obtained by the method explained for the ellipse H A T F.—E. H.

[52190.]—**Copper Reduction (Wet Process.)**—There are many wet processes for the extraction of copper from pyrites. Longmaid's process, patented in 1842, consists in roasting the ground ore in a reverberatory furnace with common salt, by which means sulphate of soda is produced, and any copper which may be present is converted into soluble chloride. The copper was separated, either with iron or lime slaked in water. This process was worked at St. Helen's for many years. Bankart's process. The material was Cuban ore, containing 14 to 25 per cent. of copper. The ore was reduced by mechanical means to a fine powder and exposed in a furnace at a low red heat, with free access of air; most of the sulphur was driven off, while a certain amount was converted into sulphuric acid, forming $CuSO_4$, which was then treated with water. The process is repeated until no more copper is dissolved out, and the liquor is drawn off and the copper precipitated by means of iron. This process was worked by the Bede Metal Company, at Jarrow-on-Tyne. At many of the Spanish copper mines the ores were roasted in heaps. The process consisted of five operations—viz., roasting, grinding, sifting, lixiviation, and precipitation. After roasting, the ore is ground in an ordinary Cornish crusher, and rock salt added in proportion from 12 to 15 per cent. Before grinding, it is necessary to ascertain the exact amount of copper and sulphur, because, on the ratio existing between these bodies depends, to a very great extent, the success of the operation. In the majority of cases the sulphur should exceed the copper by about ½ per cent.; if this is not the case, an addition of finely-ground pyrites must be made; if, on the contrary, the sulphur is in excess, more burnt pyrites must be added. *Calcination.*—The furnaces vary considerably in form. In many cases long open furnaces fired by gas are used. The furnace is something like an ordinary puddling furnace. The furnace is charged from the top by a high-level railway, as in a coke oven; and the mixture of ore and salt is at once evenly spread over the surface of the hearth, where it is kept at a dull red heat and frequently stirred by means of rakes until fit for drawing. This point is determined by taking a small quantity from every part of the hearth, and after being finely ground it is boiled with water; the residue is treated with HCl, poured off, and NH_3 added to the solution; finally, the residue from the HCl solution is boiled with HNO_3 and NH_3 again added. If it is found after these trials that the solution in HCl shows only a slightly blue tint, and the HNO_3 is free from any colour, the charge is ready to be drawn. If, on the contrary, nitric solution contains copper, it is not sufficiently roasted. During the process of roasting the sulphur combined with the soda of the chloride of sodium forming sulphate of soda, and soluble cupric chloride is formed: but, unless the process is carried on at a suitable temperature, a certain quantity of comparatively cuprous chloride is produced. The charge is about 3¼ tons, and the time required is about six hours. The HCl and chlorine which is evolved is conducted into a condensing tower, and the condensed acid and water utilised in lixiviating the calcined ore. *Lixiviation.*—The calcined mixture of ore and salt is raked out of the furnace, and whilst still hot charged into tanks which are about 10 to 11ft. square and 4ft. deep. These are made of wood and provided with a removable false bottom, either of perforated tiles or brick, supported on other bricks set on edge. Upon this is placed a layer of cinders 3in. thick, forming a coarse filter, on which is charged about 15 tons of the calcined ore. The weak tower liquors are now run in until the surface of the ore has been covered to the depth of several inches. This is allowed to remain for about two hours, when it is run into proper receivers and the tank again filled with hot water and tower liquors. In this way the tanks receive from 9 to 10 successive washings. About the seventh washing a little HCl is sometimes added. All the washings after the addition of acid are collected in separate cisterns and are employed with the next series of freshly burnt ore; the residue, which is called blue billy or purple ore, should not contain at most more than 0·15 per cent. copper. *Precipitation.*—In works in which the silver is extracted by Claudet's process, the first three washings, which contain practically the whole of that metal, are treated with soluble iodide, and the iodide of silver is allowed to settle. But when the silver is not separated the copper is run at once into precipitating tanks; these are about 12ft. square by 4ft. deep, and are partly filled with scrap iron, the precipitation of the copper being accelerated by the introduction of a jet of steam. Complete precipitation takes place in about eight hours. The operation may be considered to be finished when the supernatant liquid produces no stain on a piece of polished steel when dipped into the liquor. The precipitate contains about 80 per cent. metallic copper. In some works spongy iron is used for this purpose. In order to precipitate copper by a galvanic current, take the chloride of copper solution, and in it place a plate of copper and a piece of gas carbon, or any other suitable substance, to act respectively as a kathode and an anode, which plates are to be attached to the poles of a dynamo. If the current is properly regulated the copper will be precipitated upon the surface of the kathode; of course it is cheaper, if possible, to work the dynamo by water power. There are various other processes in use for the reduction of copper from its ores; but as I fear I have already occupied too much of the valuable space at your disposal, I do not feel myself justified at the present moment in entering into further particulars. As, however, it may possibly interest many of your readers, I shall be happy, on a future occasion, to give an account of a process which, from its rapidity, completeness, and the purely scientific principles upon which it is conducted, entitles it to a position as one of the best metallurgical processes in existence.—William E. Dawson.

[52237.]—**Soapery Joints.**—Nothing will make a good joint but actual contact. The fact that your couplings go on over the lead and hemp is palpable proof that they are too large. But granted that you could obtain, at a reasonable rate, properly-fitting pipes, you will find it far preferable to take off the couplings and use flanges, with fairly good rubber wheezes. Very great care should be observed in planning out and fitting pipes in soapworks, as alterations and breakdowns so often occur. Possibly your pipes were fixed and fastened without the slightest reference to the fact that hot leys would sometimes be used, and in a long length the expansion is an essential point to provide for. If you don't like the idea of flanges, you could use back nuts to the present couplings, jamming up five or six laps of good thread elastic; but I would strongly advise the flange joints with rubber, as each one becomes practically an expansion joint. Don't use the rubber too good, or it will, in time, squeeze over the bore of pipe, and stop flow. If you use the muriatic acid, as advised in last week's Mechanic, you will make what is practically a rust joint, and most likely have to get your couplings off with a warding chisel, with the nearly absolute certainty of spoiling the threads on pipes. All pipes in soapery, whether steam, ley, or water, should be laid with an incline to the low end, so that in frosty weather they can be thoroughly drained when work is knocked off. Steam should be turned on with extreme slowness when the pipes are cold, or the kicking will find out the weak parts, and either spoil joints or split pipes. The supply-pipe for each pan should rise from the main, so that lodgment of condensed water cannot occur. Insist upon having all nuts square; the others are pretty about an engine, &c., but utterly out of place where joints are likely to be often disturbed. Have standard sizes for the nuts, and as few different sizes as possible. Unless your boiler primes, you will find that the condensed water from your steam-pipes is practically pure. In one large soapery in Lancashire weak leys were used in place of water for the boilers, in order to obtain strong leys at a cheap rate. Will you excuse me for suggesting that some elementary knowledge of the part borne by caustic lime in making leys would prove valuable to yourself and employers, as lime is very slightly soluble, and is not dissolved as you seem to imagine. Don't be offended; but ask again if further information is required.—London Stone.

[52256.]—**Brush Dynamo.**—If Williams will supply the following details, I may be able to help him out of his fix. Resistance of A. from brush to brush, weight and resistance of F.M.'s, and the shape and construction of commutator. There are other means of increasing E.M.F. without re-winding. 2,000 per minute is quite high enough in practice.—W. H. E., Coventry.

[52268.]—**Will.**—I promised this querist an answer to the latter part of his query, viz., whether an executor can resign. Yes, he can be allowed to do so in the customary way.—G. Russell Pridham.

[52269.]—**Acoustics.**—The first of these questions is from the Honours Examination paper for May last, the word "steam" being, however, a misprint for "gas." The velocity of a sound in a gas is given by the formula—

$$v = \sqrt{\left(\frac{ghd}{D} \times 1{\cdot}4\right)}$$

Taking the temperature at zero, d in this equation is the density of mercury referred to water, which the student was supposed to remember. We have—

$$\begin{array}{lrl}
\log. g = & 2{\cdot}9916690 & \\
\log. h = & 1{\cdot}8633229 & \\
\log. d = & 1{\cdot}1335389 & d = 13{\cdot}6 \\
\log. 1{\cdot}4 = & {\cdot}1461280 & \\
\hline
 & 6{\cdot}1346588 & \\
\log. D & \bar{5}{\cdot}9493900 & \\
\hline
 & 2)10{\cdot}1852688 & \\
 & 5{\cdot}0926344 & = \log. 123770 \text{ c.m. vel. at zero.} \\
\log. \sqrt{1 + 003665 \times 20} = & {\cdot}0153605 & \\
\hline
 & 5{\cdot}1079949 & = \log. 128230 \text{ c.m. vel. at } 20^\circ.
\end{array}$$

If, instead of remembering the density of mercury, the student calculates what is the equivalent in C.G.S. units of 15lb. per square inch—namely, 1033 grammes per square centimetre, the same result may be arrived at by a slight variation in the process. With respect to the next question, which is from the Honours paper for 1880, I think the following will indicate method of solution: Assume that the length of the slip varies as the tension, then, if the tension was increased m times, the note would become $F_1 \times \sqrt{m}$ as regards change of tension, but would be altered also to $\frac{F_1 \times \sqrt{m}}{m} = \frac{F_1}{\sqrt{m}}$ by reason of variation in length. Again, the diameter would alter in the ratio $\sqrt{m} : 1$. This would make the note become $\frac{F_1 \times \sqrt{m}}{\sqrt{m}} = F_1$ or the same as before. Perhaps a numerical illustration will make this clearer. Suppose the slip originally = ·4in. diameter and 10in. long stretched by 1lb. and giving x vibrations. On increasing the tension to 4lb., the number will become $2x$, but the length increases to 40in., and this makes the number only $\frac{x}{2}$; the diameter diminishes to ·2in., which doubles the last expression, making it equal to x as at first. I am not quite certain about this string; but the above is how I would have tackled the question had it come before me in an examination.—Wm. John Grey, Newcastle-on-Tyne.

[52278.]—**Gas.**—Respecting query No. 1 of "W. A. S.," his surmise is correct; but, in No. 2, the coke produced from a comparatively short period of carbonisation would be a much less smokeless and incandescent fuel than ordinary coke is at present. Neither would it, for several reasons, be profitable to the gas manufacturer, whose chief aim is to make gas for illuminating and heating purposes, to produce a residual partially carbonised. The following suggestions, if acted upon, would, to my mind, contribute largely towards the thing desired:—1. The more general use of gas as fuel for cooking and heating purposes, the reduction of price consequent on the increased demand eventually causing it, for heating purposes—as it now is for cooking—to be more economical than coal. 2. The using of ordinary coke broken into small pieces—from 1in. to 2in. cube—burning it alone, or mixing it with coal, for domestic purposes. 3. The improved construction of stoves and fireplaces, to give more radiation of heat, combined with the better ventilation of our living rooms, whereby gas and coke, as fuel, could be more efficaciously used.—W. T.

[52281.]—**Boiling Frosted and Chased Silver Articles to Whiten Them.**—To H. J. Sayer.—I have boiled few alberts and necklets in strong solution of cyanide of potassium, and washed with soap and warm water, and dried in sawdust. All of them are a bluish colour, not white, like new. How long should they be boiled? Where do I fail? Got new tin saucepan holding a pint, and put 4oz. potassium in same, and boiled alberts about two minutes. Everyone has the same appearance. I should like to get the white colour of new articles.—Young Jeweller.

[52298].—**Bunsen's Battery.**—In answer to "S. I. M." I must say that I have not yet tried the experiment with the platinum wire you mention; but

I can give you some idea of what you might expect to get from this battery. One dozen chromate cells will be required to light [illegible] lamp for about 4 hours with one charging. [illegible] I daresay find it very expensive if you [illegible]. Why not rig up your own [illegible]. The above requires about 4lb. of sulph[illegible] of potash for each renewal. [illegible] are :- Outer cell [illegible] cylinder [illegible] containing a square [illegible] is then placed in [illegible] lasts depends entirely upon the amount of work done and the quality of the [illegible] in for two dozen cells you can produce a good steady light at a cost of about [illegible] each day [illegible] the carbon. A most convenient way of keeping them is to use the square cells, and they can be easily packed together [illegible] without any trouble. When not in use [illegible] the zincs and to place them in water [illegible]. I daresay the [illegible] chromate of potash [illegible] know that there was any [illegible] Fuller's [illegible] diluted with water [illegible] battery [illegible]—[illegible].

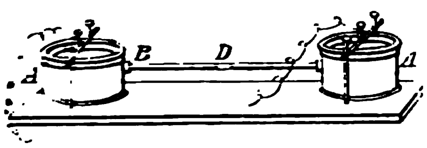
[illegible]—**Methylated Spirit.**—Break up some glue and put with it. The glue will absorb the water but not the spirit, [illegible] expense, [illegible]—[illegible].

[illegible]—**The Cheapest Food.**—I am obliged to those correspondents who have noticed my query [illegible] XXIX. [illegible] and elsewhere in back volumes [illegible] For working men, [illegible] beans [illegible] cheapest [illegible] a quart, and bacon [illegible] a pound. [illegible]

[illegible]

[illegible] the following [illegible] fitted [illegible] Brake was [illegible] Experiments [illegible] March [illegible] was sent to [illegible] London, and [illegible] 1874. [illegible] After [illegible] the automatic [illegible] St. Albans [illegible] 1875, till [illegible] has now been [illegible] The [illegible] a week after [illegible] It [illegible] Skipton, &c. [illegible] and [illegible] The [illegible] engine 156 [illegible] fitted to [illegible] Bedford [illegible] train [illegible] The next [illegible] brake were [illegible] and [illegible] to London, [illegible] the Pullman [illegible] London.—[illegible]

[52329.]—**Electrometer.**—I think that Lippmann's electrometer, as modified by Dewar, would answer your purpose. A glass tube rests horizontally between two glass dishes, in which holes have been bored to receive the ends of the tube. It is filled with mercury, and a single drop of dilute acid is placed in the tube. Platinum wires to serve as electrodes dip into the mercury in the dishes. An E.M.F. of only [illegible] of a volt suffices to produce a measurable displacement of the drop. The direction of the displacement varies with that of the current. See sketch: A A, dishes of mercury; B, tube of mercury; D, drop of dilute acid.—Ratio.



[illegible]—**Varnish for Baywood Tops of Carding Engine.**—Is not baywood the mahogany that comes from the Bay of Honduras? If "T. I." means mahogany of that ilk, let him take "M[illegible]'s" advice, and French polish. Don't use, however, but mix up tallow and whiting, and rub that in; then polish in the usual way, or apply with a brush, as I suppose you do not want a very high finish.—Nun. Dor.

[illegible]—**Legal.**—In case the widow dies intestate, you had better leave it to A.'s executor.—G. Russell Pridham.

[illegible]—**Legal.**—When a divorce has been made absolute—that is, after six months has elapsed since the hearing of the petition *nisi*—the parties have no claim upon one another. Neither are the children legally liable to support their parents; but putting aside legality in the matter—the mother, as such, and moreover being an invalid, should be shown some consideration by her children, although there be no legal responsibility on their part. Yet, whatever be the differences between husband and wife, it is certain that no child in a position to assist his mother, with a spark of filial affection left, would refrain from doing so simply because the law does not compel him.—G. Russell Pridham.

[illegible]—**Draughty Church.**—In your last week's issue, "[illegible] E. L." thinks the heating apparatus ought to be in use two or three days before the congregation meet. I think it could be heated with less expense (practically) by erecting a heating apparatus about [illegible]ft. high, or by laying an apparatus in the galleries, so that the air above will be quite as warm as the air below, and thus prevent the cold current coming down on their heads.—S. [illegible] Arrington.

[illegible]—**Fretsaw.**—The sketch illustrating this query is an absurdity. How can the small wheel pull saw properly when its centre is out of line with the saw? Let the querist either shift the saw or the wheel so that a line passes straight through their centres, and he will have no difficulty. Plenty of them in back volumes; and a dust-blower, which will give an idea, on p. 188, Vol. XXXVI.—Nun. Dor.

[52344.]—**Fretsaw.**—"A. D., Amateur" will never get his fret saw to work quietly and easily with so short a connecting rod. The whole sketch is wrongly worked out; ¾in. is throw enough for crank, giving saw 1½in. stroke. Let "Amateur" bring the crank close to the ground, directly under the saw, and with a long, light connecting rod his machine may go. The spring should be on the flat; the last I made did well. I approve of steel for working parts; but cannot approve of your arrangement which admits of too much friction.—William Hosken.

[52345.] — **Non-Condensing Horizontal Engine.**—The indicated horse-power will be 52·50, and as for the nominal horse-power, there are so many rules, all giving different results, that it would not be reliable.—Sabata.

[52345.]—**Non-Condensing Horizontal Engine.**—If you wish to know the actual or indicated power of your engine, have some diagrams taken when the engine is running with full load on. As "nominal horse power" varies considerably with different makers, the term ought to be abolished, and in speaking of an engine the dia. of cyl., stroke of piston, and revs. per min. stated instead. With the particulars given the engine would approximately indicate 136 horse-power.—Labor Omnia Vincit.

[52345.]—**Non-Condensing Horizontal Engine.**—Seeing that "Young Manufacturer" and a good few readers in "ours" is desirous of knowing the nominal and indicated horse-power of these engines, I will try and help them. The term "nominal horse-power" is of the vaguest description, as it really expresses nothing, as makers of small engines find it a convenient way for entrapping people, as a high nominal horse-power has powerful attractions for the general public. The term "nominal horse-power" was introduced by Watt, and in his time gave a fair means of estimating the comparative value of engines. But now, owing to the greatly varied conditions of engines, the term "nominal horse-power" forms no means of comparison. The following was Watt's mode of calculating the nominal horse-power of an engine: The area of cylinder for a 1 horse-power engine (high-pressure) is 10·75 sq. in., worked with an average pressure of 14lb. per sq. in. on the piston; length of stroke, twice the diameter of cylinder, with a piston speed of 220ft. per minute. The area of a cylinder for a 1 horse-power condensing engine is 21·5 sq. in., worked with an average pressure of 7lb. to the sq. in. on piston; length of stroke, twice the diameter of cylinder, and a piston speed of 220ft. per minute. So, taking "Young Manufacturer's" engine, with a cylinder area of 201 sq. in., the nominal horse-power will be 201 × 14 × 220 ÷ 33,000 = 18·77. The Admiralty rule for nominal horse-power was $\frac{D^2 V}{6{,}000}$ where D = diameter of cylinder, and V = velocity or travel of the piston per minute; then 16 × 16 × 220 ÷ 6000 = 9·4 horse-power nearly, or a difference of 9 horse-power in the two rules. Now we will deal with the indicated horse-power. The indicated horse-power can only be ascertained by the use of the indicator cards. But we will assume that your engine gets an initial pressure of, say, 75lb. gross on to the piston, that is allowing 5lb. loss from boiler pressure, which we will suppose is lost in friction and condensation in steam pipes from boiler to engine, and that the engine is perfect, that is allowing nothing for leaky piston and defective valves; the question of condensation in the cylinder we will not entertain; the indicated horse-power will be 127 nearly. The way to get the indicated horse-power of an engine is to square the dia. of the cylinder and multiply by ·7854. Then to find the number of expansions in the cylinder by dividing the length of stroke by the point of cut-off, or 42in. length of stroke divided by 14in. point of cut-off = 3 expansions, and 75lb. gross divided by 3 = 25lb. terminal gross pressure. The hyperbolic log. of 3 expansions is 1·099 + 1, so if we multiply 25lb. terminal by 2·099 = 52·475lb. average pressure throughout the stroke. But as the engine is a non-condensing one, we want the atmosphere deducting from 52·475 − 15 = 37·475 effective average. Then multiply by the piston speed 560ft. per minute, which is rather a high speed, and divided by 33,000 = horse-power

$$\frac{16 \times 16 \times \cdot7854 = 201 \times 37\cdot475 \times 560}{33{,}000} = 127$$

—Firer, Dewsbury.

[52347.]—**Vacuum Gauge.**—Your gauge showing 25in. (12½lb.) of vacuum is not at fault, because you only expected 15in. to 18in. Your engine is doing better than you gave it credit for. The indicator applied to the condenser would alone give you the correct vacuum, which is generally less than shown by the gauge.—J. F. W.

[52347.]—**Vacuum Gauge.**—If the Bourdon gauge is new and perfect, it only proves that you were wrong in your ideas of the quality of the vacuum in the condenser, as the 10ft. of ½in. piping would make no difference to the vacuum as long as the joints are sound. And if you have plenty of cold water for condensing, you ought, if the air-pump is in good order, to get a much better vacuum than 25in. For example, at the time I write, the condensing water of the engine now working is 54° temperature, barometer stands at 30·9in., and the vacuum gauge shows 28in. steady in the condenser. The vacuum gauge is extremely useful, and every condensing engine ought to have one fitted to the condenser.—Labor Omnia Vincit.

[52348.]—**Boiler Tank.**—The tank will hold 4632·398 gallons, and the weight of water will be 20·68 tons.—Sabata.

[52349.]—**Steam Mill Pump.**—You do not give sufficient data. You must state height the water is to be lifted, stroke of pump, and what quantity of water required per min. or hour. If you have an engine already fixed, state size and present work it is doing.—Labor Omnia Vincit.

[52349.]—**Steam Mill Pump.**—I take pleasure in informing "R. R. N." that the depth of the widest part of the pump (which will be double-action) is [illegible]in., and the width is 5in. I have no well, but have bends just beneath the surface. I connect pipes [illegible]in. diameter, and lay them in the clay pit, perhaps 30ft. long; but the lift is not above [illegible]ft. or [illegible]ft. I want to get all I can out in the least time.—Narva.

[illegible]—**Legal.**—C.'s remedy is by action against B. He must employ a solicitor. It is not the question of B. being justified: he would naturally sell the property for the best price he could get for it.—G. Russell Pridham.

[illegible]—**Water-Wheel.**—If you find you get enough power out of water-wheel, and such a loss of water as well, would it not be well to reduce the size of hole? Or else reduce driving-pulley and increase the speed of water-wheel, which would give you more power.—Sabata.

[52367.] — **Horse-power of Engine.**—The horse-power of "Ignoramus's" engine, according to the figures given, is 111·95, or 112 nearly.—Rollie.

[52367.]—**Horse-power of Engine.** — Find out what part of the stroke the piston is at when the slide-valve closes steam port, which is termed "cut-off," and I will work out horse-power.—Sabata.

[52367.—**H.P. of Engine.** — "Ignoramus" omits to state the point of cut-off in his engine, and also whether condensing or not. But we will suppose it to be a condensing one, with an initial gross pressure of, say, 55lb., and a back pressure of 2lb. in the condenser, and, for simplicity, to cut steam off at half of the stroke; then the horse-power will be 615·7536in. area of cylinder multiplied by 44·5lb. average pressure, multiplied by 350ft. piston speed per minute, and divided by 33,000, equals 290·6 horse-power, or thus:

$$\frac{615{\cdot}7536 \times 44{\cdot}5 \times 350}{33{,}000} = 290{\cdot}6.$$

—Fiber, Dewsbury.

[52368.]—**Red and Blue Photographs.**—I am much interested in "Machina's" reply to this query, although not the querist. If he will kindly give full directions for making the solutions—say, time the paper should be immersed in each, also if a non-actinic light may be used in the dark-room operations—it would probably be of use to others besides—Dozey G.

[52368.]—**Red and Blue Photographs.**—The sensitising solution for red or, more properly-speaking, light reddish-brown photographs, is bichromate of potash ½oz., water 16oz. The sensitising solution for blue photographs is ferricyanide of potash (red prussiate) 1dr., ammonio-citrate of iron 1dr., water 1oz. In sensitising the paper, take hold of it in the middle of each end, bend it so that you can place the centre of the paper on the solution, and gradually lower the two ends. Let the paper remain floating on the solution for about one minute, and then with your forceps take one end and slowly raise it from the solution, taking care not to get any on the back of the paper; then pin it by the corner in a dark cupboard to dry. When dry, put it in your printing frame with the negative or design which you wish to photograph, and place it in the light. On a bright day it will take from five to ten minutes to print; but you will require a little experience to get a nice colour. When printed, take it out of the frame and place face downwards in a bowl of clean water from ten minutes to half an hour, then take it out and dry. Never sensitise more than you require for one day's printing, and you should obtain some shallow dishes for your solutions. Keep your red and blue solutions in stoppered bottles, and take care to cover the bottle containing the blue solution with two or three folds of blue paper.—A. Laundy, Buxton-villas, Stratford, E.

[52381.]—**Power of Local Board in Water Supply.**—If you are willing to bear the expenses of laying down the pipes, I don't think the Board would refuse to supply the water; but if you lay the main without consulting them, you can't compel them to supply the water.—G. Russell Pridham.

[52382.]—**Plaster for Outside Walls.**—Can it possibly be clay? Surely not. It would wash off in "no time," unless the house were baked in a kiln, which does not seem practicable. I conclude that "S. B.'s" house is very old, and built in the Elizabethan style, as he speaks of it having a wooden "framework." If so, the best way would be to paint the wood red, and peck off the old cement where loose, and replaster with Roman or Portland cement, mixed with very coarse river sand, all the stones being sifted out and the very fine also.—Murano.

[52384.]—**Absorbent Cotton Wool.**—I am much obliged to Thos. Fletcher for the early answer to my query; but I am sorry to say I have tried many sorts of soda which are alkalis, but they all injure the colour and cause it to look grey, and after I have washed it well in cold water, it shows the alkali when tested. If I boil in clear water, or neutralise with a little acid, it brings it back to what it was at first. It also does not give it that snowy feeling when pressed. Shall be pleased to know the right process.—Student.

[52390.]—**Dynamo.**—Connect your F.M. with cells, and test with compass needle to see if poles are right. Two bichromates ought to make them strongly magnetic. Test A. in the same manner, to see if it produces N. and S. poles in a line with the brushes.—W. H. E., Coventry.

[52392.]—**Gravitation.**—The way to reconcile the two workings is to do them correctly. The first result should be 222·4ft., the second 3·73sec. nearly, and the third 223·6ft. nearly. Then it will be found that after rising 223·6ft. in 3·73sec. the ball will fall nearly 1·2ft. in ·27sec.—J. S. C.

[52393.] — **Water Consumption in an Engine.**—You cannot tell with certainty, from the diagram, how much water in the state of steam an engine uses. A considerable portion of steam is condensed in the cylinder at each stroke of the piston, because at each opening of the exhaust the temperature of the cyl., piston, and passage is reduced, and the incoming steam has to reheat these parts, and so more steam enters the cyl. than is theoretically necessary to do the work. Part of the steam that is condensed is re-evaporated during the stroke, and this re-evaporation is shown by the expansion line on diagram being higher than the adiabatic curve. To calculate from the diagram how much water the engine uses per hour, the rule is, multiply the volume of cyl. to point of cut-off, by the No. of revs. per min. and by 60. Divide the product by the density of the steam in the cyl., and the quotient will give the No. of cubic feet of water expended in the state of steam. But by far the best plan is to fix a water meter on the feed-pipe to the boiler, that will show the amount of water actually used, and you can calculate from that the evaporative power of the coal, and so, if necessary, check the coal merchant.—Labor Omnia Vincit.

[52400.]—**Reading Lamps.**—A query similar to yours was inserted in this paper last September, and was answered by "Nun. Dor." in the issue of Sept. 21st on p. 71, who stated that there was no remedy for the unpleasant smell, that the rubber was being attacked, and that destruction would go on until the pipe, as a pipe, was spoilt.—Machina.

[52401.]—**Pianoforte Tuning.**—To Mr. W. H. Davies.—"A. D." has probably overlooked the explanation preceding the directions given in No. 830, that "The position of the bearings lies between the F, a fifth below the 2ft. C, and the E a major third above (both inclusive)." That is, twelve notes in all. Within these limits it would, of course, be impossible to tune a fifth downwards from G. It is also correct to say, as in No. 918, that each ascending fifth should be one beat flat. If they were tuned sharp it would undo the effect of flattening the fourths, and would come to the same thing as perfect intervals throughout.—W. H. Davies.

[52402.]—**Pulley.**—Such a belt is termed a quarter twist, and needs no "carrier" pulley. The rule is, "the central planes of the two pulleys must intersect the straight line which joins their points of delivery." Now, get two pennies and a knitting-needle, and place them on the table so as to comply with the above conditions, and depend upon it, if you fail to do so, you have no business to meddle with machinery.—W. J.

[52403.] — **Repairing Dies.** — Double shear steel is not the right steel for dies. You should have mild cast steel. No shear steel will carry a good cutting edge for long. Leadbeater and Scott's special die steel would suit your purpose. I know from experience.—E. T.

[52404.]—**Strains.**—If "span" should be spar, and if I understand the question, then the vertical strain on each end is 5 tons, and it is not altered by the spar not being level. But there will be horizontal strains on the masts, depending on how much the spar is out of level.—J. S. C.

[52406.]—**Cylinder Electric Machine.**—What is the use of the pieces of tinfoil gummed on to the cylinder? I never saw them recommended in any book, and I'm inclined to regard them as the cause of all your woes. Try the machine without them, and see if it works better. I suppose the cylinder is dry inside, and the rubber, &c., was hot when used? There must be sparks somewhere, one would think, or you would not feel a pricking.—R. A. R. Bennett.

[52406.]—**Cylinder Electric Machine.**—My first machine was a very similar one, and gave plenty of sparks, but I never heard of strips of tinfoil being pasted on the cylinder. If the machine does no better when they are removed, and the cylinder has been well cleaned, probably the insulation is at fault. The prime conductor should have no sharp angles or roughnesses on its surface, and its ends should be round and smooth. The tube on which it stands will insulate much better if warmed and varnished with shellac dissolved in methylated spirit. To obviate condensation of a conducting film of moisture on its surface, of course the machine should be warmed before using.—J. Brown, Belfast.

[52407.]—**Oxy-Hydrogen Light.**—In reply to W. Hobbs I must say that I have worked the lime-light for about 20 years in almost all the west-end theatres in London and elsewhere. I should advise my friend to be very particular in the following hints: 1. See that the bags are free from air before filling them, as this, when mixed with other gases, is liable to cause an explosion. 2. If you use single boards, have an equal pressure on each bag from beginning of lighting till done. I always use a 75lb. weight for each bag (ordinary size). You can put as much weight on the bags as you like in using the double boards. In lighting, the hydrogen should be ignited first, and the oxygen turned off first when you have done with the light. There would be no fear of an accident if the greatest care is taken. Pure hydrogen gives a more intense light than the carburetted: it would not be noticed if the oxygen gas is made from the purest chemicals that can be got. I should be glad to give any further information whatever. Do you make your own gas or buy it, and where do you purchase your limes, and what kind do you use?—as this depends entirely upon the kind of light you will get from these two things.—Lime-light, 228, Hill-street, Walworth.

[52409.]—**Legal.** — Here B. has only a life interest in the property, and therefore she cannot will it away to whom she likes, as after her death the property was left to her eldest son, C., who dies during her lifetime, leaving two sons, who are entitled to succeed to the property after B.'s death in preference to B.'s other children.—A Liverpool Subscriber.

[52410.]—**Dynamo Machines.**—The relation is variable, because, with a coil of given resistance, area, and number of turns, the E.M.F., and consequently the current, will depend on the strength of the magnetic field, and on the speed of rotation. It would not matter if the coil were a flat strip or a round wire so long as their resistances for a given length were the same.—W. H. E., Coventry.

[52417.]—**Siemens Dynamo.**—This is the most tiresome and tedious A. to wind that "Constructor" could possibly pick. Size of wire, No. 18 double c.c. I cannot very well explain winding and connections to commutator without diagram, which I will send if you feel equal to the job.—W. H. E., Coventry.

[52422.]—**Legal.**—"Tom" can certainly take away the fittings if they can be removed without substantial damage, and provided they were not the landlord's property, which the outgoing tenant sold to "Tom" as his, which is of frequent occurrence. "Tom" must also remove or sell them during his term; but should "Tom," at the close of his tenancy, take a lease of the premises, he must take care to reserve his right to remove his fixtures, which he is entitled to sever under his first tenancy, otherwise, being on the premises previous to the commencement of the second term, they will be irremovable when it expires.—A Liverpool Subscriber.

[52426.]—**Voss Electrical Machine.**—I was troubled with this cracking of the plate of a Winter machine mounted in a similar way, and I attributed it to unequal expansion of the glass when the machine was warmed, the outer part of the plate expanding and straining the centre, which, being shielded from the fire by the mounting, remained cold, and gave way at the hole which is, I presume, the weakest part. If this is the case, the remedy would obviously be to allow the part about the hole to warm also. The brass cheeks might be made in the form of rings with arms not in contact with the plate, or portions of the rings might be cut away so as to leave still less of the plate under cover.—J. Brown, Belfast.

[52432.]—**Railway Time Signals.**—In 1873 the Midland Co. erected a self-acting time indicator at Kegworth, showing the time a train had passed up to 15 minutes. It was set in motion by the passing train depressing a lever attached to the rails, and communicating with the clockwork; at the expiration of the fifteen minutes the pointer returned to its normal position. It has since been abandoned, as not proving sufficiently reliable. At Whiston Bank, on the Liverpool and Manchester line, a train-actuated signal was in use in 1867, but was subject to failure. The same result has also attended the use of similar signals on the Brighton line, and they were both ultimately abandoned.—Nomen, Liverpool.

[52432.]—**Railway Time Signals.**—There is a model of a railway time signal to be seen in the Crystal Palace, called "King's Electric System of Railway Signalling." The arms of the semaphore signals are worked by electricity, which is brought into operation by a plate inside the rails which the train depresses in passing over. Each train, by passing along the line, puts at danger the signal it has just passed, and at the same time takes off the signal behind the one just put on, which till then had been at danger. There is a clock on each signal-post, which, as each train passes, is put back to zero; and so it shows to the driver of each successive train how long it is since the train in front of him has passed the post. This invention has been patented in England and several other European countries.—Machina.

[52435.] — **Extraordinary Phenomenon.** — There is not much doubt that the unusual colours are due to the influence of particles of something in the atmosphere, but whether that something is terrestrial (volcanic) dust, cosmic dust, or the remains of some exploded comet or meteoric shower remains to be proved, if possible. The sun himself has been observed to be green and blue in parts of the world, and as soon as the accounts are "all in," it will be possible to arrive at some conclusion as to the nature of the phenomenon. Personally I suspect that something is due to colour blindness on the part of the observers, for some of the accounts are indeed extraordinary.—NEW. DEN.

[illegible]—**Extraordinary Phenomenon.**—During the past fortnight we have had a series of wonderful and beautiful sunset and sunrise effects in West Lancashire, as though there was some hazy matter suspended in the atmosphere at a greater elevation than the usual vapour planes, which haze appears to catch the light earlier in the morning and later in the evening than the highest cirrus cloud in ordinary circumstances. An idea has been started that these effects result from a wide diffusion of volcanic ash vapour from the Java eruptions and there may be some probability in this suggestion. When I was in the Bay of Naples two years ago, the haze produced over large tracts of South Italy by Vesuvius was very noticeable, and the sunset colours were very similar to those we have lately experienced, particularly a rosy pink glow in the [illegible] part of the sky *after sunset* for some time. This was very noticeable here on the [illegible] [illegible] it changed in a few minutes to a sea-green tint.—HARVEY.

[illegible]—**Ventilation of Rooms.**—It is impossible to give any rule for the ventilation of rooms which is worth having. The force which causes the air to move is constantly changing in amount with every change of temperature, so that if a rule was given it would be of no practical value. I can however give some data from which "H. W. [illegible]" can derive some practical idea of the conditions necessary to effect his object. A room [illegible] provided with three openings [illegible] at the bottom and one opening [illegible] by [illegible] at the top, opening direct through the wall into the chimney, which rises [illegible] above this point, will be sufficiently ventilated when there are 12 persons and five gas-burners alight in the room, each burner consuming [illegible] per hour. The temperature outside is at [illegible], and the temperature inside [illegible]. The room has no fire in it, but is heated with steam pipes. With [illegible] persons, and the same gas burning, the room does not become unpleasant when so used for two hours, but the temperature then rises to over [illegible]. With the same sized room [illegible] with only [illegible] of chimney [illegible] the ventilation is not quite sufficient when there are [illegible] persons in the room, even for two hours, but is quite sufficient for seven persons for an unlimited time. When there is a difference of [illegible] between the inside and out the ventilation under the circumstances mentioned is not quite sufficient. It is a matter of [illegible] that the [illegible] should be placed as [illegible] and that it should [illegible] with no bends if [illegible] In this case it is as well [illegible] and not in [illegible] the chimney. It is also [illegible] will not be affected [illegible] I have only briefly [illegible] important matters to be [illegible] generally. I would [illegible]—A. [illegible]

[illegible]—**Transparencies.**—To remove your [illegible] put a piece of white [illegible] a few days, and shake [illegible] glass well and [illegible] if you like, with [illegible] Your [illegible] with ease. It [illegible] glass globes. [illegible] of expense and [illegible] I have seen [illegible] of time and [illegible] that as my [illegible] either the [illegible] gelatine the [illegible] temperature of the [illegible] varnished with [illegible] make them wash- [illegible] working from one [illegible] This class of [illegible] glass is useless, [illegible] without a [illegible] we had at Mont- [illegible] I saw some very beau- [illegible] done by a [illegible] the address, but I [illegible] he writes. I [illegible] catalogue," and [illegible] might be able [illegible] would be no harm [illegible]

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

51876. Calls for Birds, p. 116.
51877. Telephone for 140 Miles, 116.
51880. Pressure on Screw Propeller, 116.
51896. Pise Blocks, 116.
51901. Chief Rent, 116.
51906. Diaphragms. To Mr. Lancaster, 116.
51907. Turbine To Mr. Lancaster, 116.
51911. Employment in Canada, 116.
51913. Hydraulic Rams, 116.
51918. Eyepiece, 116.
51919. Ampère Meter, 116.
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52123. Oxide of Copper Battery, p. 204.
52124. Precipitation of Copper, 204.
52129. Polishing Tiles, 204.
52132. An Excellent Yeast, 204.
52133. Sulphur in Coal Shaft, 204.
52135. Mechanical Race-course, 204.
52136. Galvanising Wrought Iron, 204.
52153. Lens, 205.
52158. Slide Rest, 205.
52164. Pile Work, 205.

QUERIES.

[52446.]—**Model Boiler.**—I have a horizontal copper boiler 9in. diam., 18in. long, copper 3-16in. thick, brazed seam, ends flanged down ¾in. over body and brazed on, no stays or rivets, externally fired. Will some one kindly tell me what pressure it will stand, and also how to make lever safety-valve to blow off at working pressure or a little above?—C. E. B.

[52447.]—**Boiler for Model Engine.**—I have a model horizontal slide-valve engine 1½in. bore 3in. stroke, for which I wish to make a boiler (iron riveted), capable of burning coal or coke. I should feel greatly obliged if some kind reader would give dimensions of same, also some idea how to proceed in making. I wish to run the engine about 150 revs. per min.—ESMERALDA.

[52448.]—**Peat Litter.**—Could some of your numerous correspondents give me any particulars respecting the manufacture of peat litter? Also the cost of such machinery as may be required, and from whom could the machinery be had?—A. M.

[52449.]—**Greek Inscription.**—In 1813 Sir W. Gell found a bronze tablet in Olympia on which is inscribed an agreement between the Eleans and the Heræans. It is said to present examples of the obsolete digamma among its letters. Where can I find a full account of this tablet, and a translation of its inscription?—STUDENT.

[52450.]—**Fatty Acids.**—Wanted a simple and ready method for the quantitative estimation of neutral fats in mixtures of neutral and acid fats. What is the best handbook on the subject of the commercial testing of fats, and also on the manufacture of oleomargarine?—VICTORIAN.

[52451.]—**Peculiarity in Vision.**—The following experience is not only very interesting to me personally, but will I think be so to many of your readers, and I shall be glad if it can be explained to me. Usually my eyesight is perfect—indeed I think rather above the average, both for long and short distances, and in respect of capacity for much work without a trace of weariness. At times, however, without any warning, and at uncertain intervals of days, months, and even years, objects looked at diminish in size precisely as if I saw them through the wrong end of a powerful telescope; and in the same way, without losing sharpness of definition, they seem removed to a great distance. This is accompanied by a feeling of stress somewhere about the eyes, much the same as when looking at an object so close as to necessitate a slight squint. The longer I look at the objects the smaller and more remote do they become, until the sense of stress grows unbearable. Relief is had by closing the eyes, rubbing the face as if washing it, or by going to the open air where the gaze can be fixed on distant objects, or conversely by looking at something very close to the eye. For example: A newspaper in my hand will suddenly seem no bigger than a shilling, and persons in the room appear of corresponding size; but if I gradually let my eyes travel along the paper and up my arm until I see my coat collar, somewhere on the way I recover my ordinary vision; but probably it will go wrong again in a second or two if I again look at the articles surrounding me, unless I go outside, or wash my face, or move about very quickly. When in bed with my eyes shut, even in the dark, I can at once tell by the feeling that I am so affected, and have repeatedly proved it by experiment. I have described the case to several medical men, including one learned professor who makes a special study of the eye, and I am myself fairly read in physiology and optics; but I have yet failed to discover any solution of my difficulty. I have never yet known any person who had experienced the same thing, except a younger brother of my own, who, not being aware of my gifts, lately described to me, with much surprise, a similar peculiarity in his own vision. The matter causes me no inconvenience even when frequent, and I have only had it once or twice during the last few years; but I should like if any of your correspondents could give me an idea what is its cause optically, what its probable cause pathologically, and whether the ailment is actually a rare one? I hope that only those who know will occupy space with reply.—CORSEA.

[52452.]—**Annuities.**—Required to know the principle upon which the formula

$$A = \frac{P}{n} + \frac{Pr + Pnr}{2n}$$

is based?—M. S.

[52453.]—**C.R. Locos.**—Can "Carstairs" tell me whether the rebuilt single passenger engines, 76, 78, and 114 are a success? Whether Drummond has modified any more of the old 8ft. 2in. singles besides the above, and what size of cylinders they now have?—W. THOMPSON.

[52454.]—**Butcher's Ice Room.**—Will any kind brother with experience of the above room kindly help me? I want constructed or to purchase a wood ice-house, room, or cool meat store, and shall feel much obliged with a little advice on the following points. If hollow sides are compulsory, and if the space is packed with anything? If so, what? and width of space? The best position for ice, and mode of keeping it? Is air ventilation compulsory? If so, does it require much, and if best to pass over the ice on entering or leaving the room? Size of room required, inside, about 6ft. by 4ft., and 6ft. high.—M. SYKES.

[52455.]—**Shaft Journal.**—Would any correspondent oblige me with a rule for determining the length of shaft journals, where the pressure on the journal, the diam., and speed are taken into account? What I really want to know is what length should the shaft journal be when the diam. is 11in., pressure on the journal six tons, and speed 120 revs. per minute.—ANXIOUS.

[52456.]—**Electrophorus.**—I have made an electrophorus in the following manner: The lower part consists of a tin disc 10in. diam., having a disc of ebonite 1-8in. thick glued to its upper surface. The ebonite is hard and polished. The upper or movable part of the instrument consists of a tin disc 8in. diam., having a glass handle, sealing-wax varnished, cemented to its upper surface. On exciting the ebonite with warm flannel, and using the instrument in the usual way, I can get no spark, and only the very feeblest signs of electricity in the disc. What is the cause of the failure? The ebonite disc has a hole 1in. diam. in its centre; the tin disc below the ebonite has a hole 3in. diam. in its centre.—W. P. K.

[52457.]—**Electric Lighting.**—Will Mr. Lancaster or some other friend versed in matters electrical advise me on the following points? I am shortly returning to Tasmania, and am desirous of introducing into part of my factory there the electric light on the incandescent principle. I left behind me a large quantity of No. 14 double-cottoned and paraffined copper wire, and if this could be utilised in the manufacture of a dynamo, so much the better. I have any amount of driving power at command, and the mechanical difficulties of the work are not to me very serious obstacles. What I want to know is (1) the best form of dynamo to work 20 to 25 Swan lamps? (2) Whether this same dynamo could be wound and connected to work two large Brush arc lamps (*a*) by themselves (*b*) simultaneously with the incandescent lamps? (3) The proper mode of connecting the systems, either separately or working together? If the reply will trespass too greatly on the space of our journal, I should feel grateful for a reference to some work upon the subject from which I may gather what I need. I have all the vols. of "ours" to 1870.—MISANKERR.

[52458.]—**To "Sigma."**—I can transmit signals at the rate of 30 words a minute through a rheostat resistance exceeding that of the Atlantic cable by about a thousand ohms. Could I send the same signals through the cable itself? If not, please say why?—HIGHLANDER.

[52459.]—**Watch Winding.**—Would any of your contributors show me how to place the mainspring winder to the barrel to wind up the spring, as I am at a loss? I have bought one, and tried to place, and cannot.—AMATEUR.

[52460.]—**Casting Lead.**—Would one of our readers kindly inform me what is best to cast thin lead in, plain and ornamental? If in sand, what kind? If in moulds, what sort will stand best with frequent use, and if anything is used to make them leave the same clean?—A. B. C.

[52461.]—**Boiler Templates.**—Can any reader kindly inform me the best mode of making templates for large heavy circular boilers double landing, or how to pitch off the holes for double riveting?—J. B.

[52462.]—**Bourdons.**—In adding bourdons to an organ with 1½in. wind, would there be any difficulty, with skilful voicing, in obtaining a good round full tone? Pressure of wind cannot be increased (for reasons too long to go into); but the bourdons can have plenty of wind and be of good scale. Early information will oblige—S. O.

[52463.]—**Famsbottom Scoop for Locomotives.**—Will any reader kindly give sketches, showing the general construction of the Ramsbottom scoop. Also a formula for calculating the height to which the water can be raised relative to the speed.—FEED-PUMP.

[52464.]—**Transmission of Power by Electricity.**—(1) What machines or apparatus would be required to transmit 100 h.p. two miles for pumping purposes? (2) Suppose the engines are at one end of line and pumps at the other, what loss would there be of power if engine was doing, for instance, 100 indicated h.p. Would there be 100 at pumps, or how much less? (3) What would be the probable cost of electrical machines and apparatus to transmit 100 h.p. nominal? The pumps must be at a certain place, and if engines and boilers are there also, we have to pay for coal 5s. per ton; whereas by having engines about two miles from pumps, fuel can be had for nothing, and not even the expense of carting.—F. W. B.

[52465.]—**Belt Working off Pulley.**—I have a flywheel 8ft. and a pulley 22in. diam., distance between centres 12ft. 9in. They are connected by a belt of Helvetian leather 7in. wide. Speed of pulley from 290 to [illegible] revs. per min. The belt is always working off one side of pulley. I have had 2½in. wooden flanges fixed on it; the belt, which is quite tight, works up the flange turns completely over. I should add, the pulley is 10in. wide, and though it may be 1-16in. convex towards the edges, the middle 7in. are quite flat. Will anyone kindly suggest a remedy?—A. B. C.

[52466.]—**Cross Belts.**—I have two pulleys, one 3½ft. and the other 1ft. diam., distance between centres 16½ft., connected by a cross belt 6in. wide. The speed of the small pulley is from 1,000 to 1,200 revs. per minute. The belt, which is a stout patent cotton one: has only been in use a short time, and chafes so much that it is reduced to 4in. in width, and will soon be useless. Can anyone kindly recommend me how to prevent it, or would a 4½in. leather one do better?—A. B. C.

[52467.]—**Paper Making.**—Will some one practically acquainted with paper-making kindly inform me of the various requisites, as local position, supply of water or other power, and other matters, to the successful establishment of such a business where there is nothing of the kind for many miles round? Is it a lucrative trade? Please add any other particulars calculated to assist. What is the best work on the subject?—Semper Quærens.

[52468.]—**Colouring Lantern Photos.**—Will any correspondent kindly tell me how the best lantern photos are coloured? I inquired at an optician's, and was informed that the best moist water-colours are employed, and subsequently varnished. I procured some of those recommended, and carefully coloured one of my slides, dabbing out the skies as directed, and then varnishing; but, as I anticipated, the result was not satisfactory, the colours appearing muddy, and very different from the pure translucent colouring on those I buy. I feel confident, therefore, that some other medium than water must be used, and if any correspondent would be so obliging as to enlighten me I should be very grateful, as I have a large number of photo. slides which I bought at the Polytechnic effects, and should much like to colour well.—Beta.

[52469.]—**Fire and Marine Insurance.**—Can any reader say where I can find answers to the following questions, or any one of them?—Has the proportion of houses destroyed by fire increased since insurance become common, and if so, by how much? Have insurance premiums tended to rise or fall (indicating a variation in the risk), and in what proportion? What proportion of fires is considered to be incendiary in order to obtain insurance money? Has the proportionate amount of wrecks increased since marine insurance became common, and have premiums increased, and in what proportion? Reliable statistics are required.—J. Brown, Belfast.

[52470.]—**Malting and Malt Kilns.**—Would any reader kindly give me full particulars how to malt a small quantity of barley, say eight bushels? Also sketch of small kiln for drying same.—Córdobese, Rio Segundo, Argentine Republic, South America.

[52471.]—**Disinfecting.**—I still want a sketch of a gas-heated baking oven for clothes, to destroy "germs."—Bow.

[52472.]—**Sailing.**—If the rough surface of the canvas sails of a ship could be smoothed and glazed like a shirtfront, would the vessel sail faster or slower?—Wave.

[52473.]—**Millstone.**—I shall be glad if any practical miller or millwright can tell me the effect of great heat on French burr stones. There are a number in a mill that has been on fire. They must have been exposed to great heat, as the shafting overhead had fallen on to them, and was bent double with the heat. The top or running stones were on, so that the stone faces were not exposed to the direct action of the fire. What I wish to know is, will the stones be again fit for work? I have not an opportunity to see them, and think it very probable that some of your numerous readers may have had experience in corn mills that have been on fire, and whether the stones were again fit for work.—Tyke.

[52474.]—**Strains on Jib Chain of Derrick Crane.**—Would any readers inform me how to ascertain the strain on the jib chain of a Derrick crane at any position in which the jib may be placed, and carrying a given load, say 10 tons, on the burden chain?—Radnor.

[52475.]—**Weakened Beam.**—There is a beam in the belfry of Maiden Newton Church supporting the bellcage, Memel timber, 13in. by 12in., the 12in. being the height. It has had a piece cut out of the side, 17in. from one end, 10in. long by 3½in. deep. I calculate that the beam when whole was equal to a safe load of 184 cwt. equally distributed between the bearings 18ft. apart. What is the loss by the piece being cut out?—M. H.

[52476.]—**Ferromanganese.**—Is this substance an alloy of the two metals, and is the carbon it contains combined or not? If combined, what chemical formula would represent its composition? In what way does it act on the iron in the Bessemer and the Siemens' processes for the production of steel?—Salvo Jure.

[52477.]—**Sheep's Teeth.**—What is that bronze-coloured metal-like deposit found on the teeth of sheep, and from what source is it obtained?—Salvo Jure.

[52478.]—**Whitewashing.**—What is the size mixed [illegible]ith white and colour-wash to prevent it from rubbing [illegible] easily, and in what proportion is it used?—Salvo Jure.

[52479.]—**Electric Clock.**—I wish to connect an [illegible]ectric single-stroke bell with the hammer of an ordinary [illegible]ock (in another part of the house) which strikes the [illegible]ours. How can I make the contact so that the bell [illegible]ll be struck the same number of times, &c., as the [illegible]ock strikes? Which is the best battery?—Nomen, [illegible]verpool.

[52480.]—**Barrel Organ.**—I am about to make an [illegible]gan with Munro reeds. I have the levers (32) ready. [illegible]ant two reeds to each lever. Can any friend kindly [illegible]e me a sketch how to put my reeds, showing palate [illegible]d plunger? What size bellows will be required? It [illegible]l be in a case with lid to open.—A. B. C.

[52481.]—**Battery.**—What is the "Powell," recom[illegible]nded (p. 3 8), but not described, by "Current" (No. [illegible]60)?—Antares.

[52482.]—**Electric Bell.**—A 4in. bell, at times only, refuses to work, even when the battery is in good order, and connections good and clean. It seems as if the contact spring stuck to the pillar screw. The bell is hung upside down; consequently, the contact at screw is always good, and the armature is only distant from the cores about ⅛in. Can any fellow-worker assist me to discover the fault? The bell is sent out by a good London firm.—R. Hannen.

[52483.]—**Neuralgia.**—For the last eight or nine months I have been suffering from severe pains in the head, which I have attributed to rheumatism, but have been told that my symptoms are those of neuralgia. These attacks, for the last 12 or 14 weeks, have come on every eighth day—viz., Sunday, at almost the same hour (3 p.m.), and continue, with more or less severity, until Tuesday morning. The first symptom is that of a band being tightly pressed across the bridge of the nose, then that of a heavy weight on the top of the head, and acute pains at the back of the ears, with a bursting sensation; in fact, the whole head is in pain, and once or twice it has extended to the throat—as if I should be choked. The effect on the spirits is most distressing. My occupation on Sunday is the same as any other day. My age is 40. I have for many years suffered from rheumatism in the limbs, but now am quite free. The doctor has ordered tonics; but nothing that I have yet tried has done me any good. I am a butler, but have had to be "nursing valet" to my aged master for the last year. If any of your readers could suggest a remedy, I should feel most grateful.—C. J.

[52484.]—**Dark Slides.**—Seeing that Mr. Lancaster has failed in his promise to give us his paper on the above, will some of "ours" not take up their pen and finish what he has left undone? I would like to get mine made during the winter to be ready for next summer.—Working Man.

[52485.]—**Income-tax.**—Will a legal correspondent kindly inform me whether a shareholder in an English Railway Co., whose annual income amounts to less than £150, can be called upon to have the sum due to the tax deducted from interest, dividends, &c.? In other words, is the tax charged upon the income of the company or that of the shareholder?—P.

[52486.]—**Cracked Fireclay Furnace.**—I have one of Morgan's portable furnaces, the fireclay casing of which has cracked in several places, more especially round the opening, and as these appear to get larger after every using, I should be greatly obliged if Mr. Fletcher would tell me what to stop them up with.—A Two Years' Subscriber.

[52487.]—**Telephone.**—Would "Sigma," or some other reader, give me a diagram of the usual method of connecting the telephone, transmitter, push, bell, battery and commutator at each end of a telephone line? I am using an ordinary microphone as a transmitter. Also, what is the most convenient form of commutator to use?—J. C.

[52488.]—**Silver Solution.**—Will some reader tell me what is the matter with my silver solution? I made it by the battery process by dissolving 1¼oz. of cyanide of potassium in 1 gal. of pump-water. I connected a piece of silver to the positive pole of a Bunsen battery, and filled a porous cell the same size as that in the battery with some of the solution, and placed it in the hole, with a piece of copper connected to the zinc of the battery. I let the batteries work for 12 hours, and then weighed the silver plate, and found only ¼oz. of silver had dissolved in the solution. The articles coat bright in a few seconds; but when I take them out of the vat and rub them, the silver comes off.—H. C.

[52489.]—**Rain-Gauge.**—Will some friends kindly give designs for a good self-registering rain-gauge—one that will give strictly accurate results, and yet not be costly? I want a standard instrument that occupies but little space, and yet the rainfall can be seen at a glance—the rain-gauge being in an open space some distance from the house; so supposing one has not time to empty it, yet by taking its reading the amount can be deducted from the following day's rain, and the record will still be perfect.—M.M.I.Sc.S.

[52490.]—**Weight of Pump Valves.**—Will any brother reader of "ours" kindly inform me what weight the valves should be of a 6in. plunger pump for supplying an accumulator working under a pressure of 260lb. per sq. in.—valves 4in. diam.? I have found that they will not act with certainty unless weighted, or kept down by a spring, although only rising about ⅜in. from their seat. I should be glad to know how to calculate the above, and to understand the necessity for a spring, as it does not seem necessary when working under light pressures only. I should also be glad to know what would be the difference in time of descent of a metal body falling through air and water.—J. Thorpe.

[52491.]—**Legal.**—During the summer of this year I made and sold several bicycles, for which I sought orders. Amongst the number was one for a man, and had to be £5 15s., and to have the use of an old one to learn on, to save the new one until he was able to ride. After using the old one and getting nearly learnt, he tried the new one on three occasions, and then never looked near hand any more. Some few weeks ago I wrote him, asking payment and to have the machine taken away, and his reply was, He never ordered it. I can produce witnesses to prove he pointed out a certain machine in stock was his own and the one he tried. He also let other men learn and use the old machine without my consent. Ought I to give him notice, and sell it by auction, and sue him for any deficiency and expenses, or what lawful course should I take?—Evens, Oakland.

[52492.]—**Legal.**—My wife has 2-5ths, and her sister 3-5ths, of rents of property under their father's will. On their death the property reverts to my children. The trustees are dead, and none reappointed. The sister has possession of the title deeds, and says she has given them to a friend of hers for safekeeping, but won't name the party. In whose hands should the deeds be placed? as they might be difficult to get on her death.—A. Slater.

[52493.]—**Nickel Castings.**—In casting above I am continually having my work spongy. I have tried different kinds of nickel, copper, and spelter, also various fluxes, but have failed to obtain satisfactory results. Will some of "ours" kindly help me?—Aberystwith.

[52494.]—**Violoncello Making.**—I am obliged to "Fiddler" for his reply to my queries as far as he has answered them. I am also obliged to Mr. Leslie for giving a few dimensions, and may take advantage of his generous offer to correspond privately by advertising my address on an early day. Meantime, I should like to know what thickness the ribs ought to be.—Edinburgh.

[52495.]—**To "Jack of All Trades."**—On p. 48, Vol. XIV., you give cut and description of small furnace. Will you kindly give dimensions of one suitable for melting 15 to 20lb. of iron, particularly height and diameter (inside) of chimney? Also what kind of fuel should be used? Do you think a little fireclay mixed with compo. would be any improvement to it, or would it be better to apply a lining of the former? If so, how should it be applied so that it will not crack and strip off, as this has been the result in former dealings with this material.—C.

[52496.]—**To Find the Magnifying Power of a Telescope.**—Sir D. Brewster gives the following method of finding the magnifying power of any telescope: "Having put up a circle of paper an inch or two in diam. at the distance of about 100 yards, draw upon a card two black parallel lines whose diam. from each other is equal to the paper circle; then through the telescope view the circle with one eye, and the parallel lines with the other, and at the same time let the parallel lines be moved nearer to, or farther from, the eye till they seem exactly to cover the circle. The quotient obtained by dividing the distance of the paper circle by the distance of the parallel lines from the eye will be the magnifying power of the telescope." Has the above method been proved to be an accurate one? Would the results be equally correct if the distance of the circle was reduced to half the amount? and if so, must the size of the circle be reduced proportionately?—A. A.

[52497.]—**Chromate of Lime Battery.**—Will "Sigma" kindly tell me the best proportions to use for a double cell battery of this kind? I purpose using the porous cell to hold the zinc plate, immersed in salt and water or sulphate of zinc, so that the zinc may always be left in.—Gulliver.

[52498.]—**Thermo-Electric Battery.**—I want to make one sufficiently powerful to decompose water, but cannot find out the two best metals to use. I have tried antimony and bismuth, but the latter is both too expensive and bad to make castings of. I believe "Noe" make his with German silver and some other metal; but what is this other metal?—I will be glad of any hint whatever.—Gulliver.

[52499.]—**The Westinghouse Engine.**—To Mr. A. Jamieson.—I am much interested with the engraving on p. 284. Will Mr. Jamieson kindly furnish a section of the Westinghouse engine, and details of parts?—Historian, M.I.M.E.

[52500.]—**Leather for Camera Bellows.**—What would be the best kind of leather, not considering cost, and what kind the cheapest? Should it be stout or light? What name as sold by leatherseller? Would black velvet be the best material for lining it?—C. W. Clifford.

[52501.]—**Match Making.**—A mechanic is going to America, and wishes to start in the match trade. Would any fellow-reader give him any information about the machinery and chemicals he requires, and how to mix the chemicals?—Progress.

[52502.]—**Telescopic.**—Can Jas. Dunlop (letter 22102, p. 304) give process for reducing platinum on glass instead of silver?—H. E. S.

[52503.]—**Gas Black.**—Would some of your readers inform me how to prepare gas black for polishing, and the best means of using it?—An Old Subscriber.

[52504.]—**Legal.**—To Mr. Wetherfield.—The local authorities have put into force their powers under the Public Health Act, 1875, in respect of making up paving, channeling, and lighting a private road in which I hold a leasehold house. I am anxious to know who is the proper party to pay for this improvement, the ground landlord or myself.—R. M. G.

[52505.]—**Lacquering Burners.**—I bought a quantity of lamps last season, and not selling them all, I packed them away till this season, when, on opening the case, I found that the burners were black and tarnished. Would any kind reader inform me how I could lacquer them to make them resemble new ones?—H. W. D.

[52506.]—**Windmill.**—Could any of "ours" kindly inform me the size a windmill ought to be to drive a two horse-power in a good breeze, the size of each sail, and how many there ought to be? Also, how to arrange the machinery so as not to interfere with the windmill standing straight with the wind as it turns to face the wind? Also, the best form to make it?—A. J. P.

[52507.]—**Photometer Dark Room, &c.**—The gas company with whom I am connected having resolved to purchase and to fix one of "Sugg's Dr. Letheby's" 60in. photometers at their gasworks, in order to meet the requirements of the Gasworks Clauses Act, &c., I should feel much obliged to any friend who would kindly give sketch and plan of small building to be erected at the entrance to gasworks suitable for the above, the said building to be so arranged internally as to be utilised as office, and to contain the "bar" of weighing machine. Also best mode and material for giving the interior walls a dead black colour.—Trydanydd.

At the Court Opera at Vienna tiny incandescent lamps, suspended by fine swinging wires, give the effect of swarms of fire-flies flitting about a tropical forest. By switches the current is turned off and on at the pleasure of the operator, and the effect, as the artificial fireflies flash and dance in mid-air, is said to have been electrical in other than a literal sense.

ANSWERS TO CORRESPONDENTS.

*** All communications should be addressed to the Editor of the English Mechanic, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

CHRISTMAS.

The next number but one of the English Mechanic will have to go to press on Monday, Dec. 24, in consequence of the Christmas holidays. All advertisements, therefore, for the issue dated Dec. 28, must reach the office by 1 o'clock on Dec. 24, and advertisers will oblige by sending, if possible, by the previous Saturday.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 12, and unacknowledged elsewhere:—

Harold Messer.—C. S. Stock.—T. Dockray.—R. G. Jackson.—J. Pickard.—W. H. Bailey and Co.—J. Birchall.—J. Barrett.—H. [illegible]—W. G. Penny.—Major Galloway.—A. [illegible]—[illegible] Brown and Son.—J. A. Schlaeft.—Col. Pendall.—T. L. Stock.—Questor.—A Young Beginner.—[illegible] Floyd.—[illegible]—A Fellow of the Royal Astronomical Society.—Geo. Parke.—Francis Horne.—X. Y.—Wm. [illegible] Grey.—G. B.—Cambrian.—W. E. C.—[illegible] Templeton.—W. E. Dawson.—An Amateur [illegible]—W. W.—[illegible] B. Allen.—Frank Mason.—Heraman.—M.I.M.E.—Weston.—Edwin Haines.

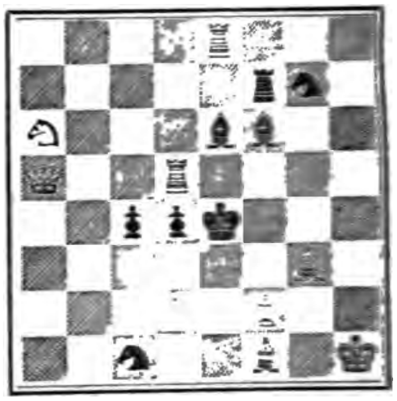
Alfred. Hydrofluoric; but the parts to have the frosted appearance are exposed to the vapour of the acid. See p. [illegible], Vol. XXXV.—A Young Engineer. It depends on what you wish to learn. "Goodeve on the Steam Engine," Lockwood and Co., is a good book, and there are several others. See the catalogue issued by Mr. Calvert, [illegible] Jackson-street, Manchester.—An Old Subscriber. [illegible] suitable, of course, if you have a suitable water supply. We do not know who makes the special turbine referred to, but you can get them from many firms.—[illegible] [illegible] in adding lime cream to the water and in passing it through filter presses to save time. The simpler process is to allow the water time to deposit the lime.—[illegible] The query has too much of the nature of an advertisement. See the list of Back Numbers under Copying Processes.—W. [illegible] The remedy is a purgative, followed by a salt-water enema. See the indices.—B. Buckland. A piece of [illegible] end of spring, and a bit of sheet platinum soldered on to touch against the point. See many papers in back volumes.—A. [illegible] Described many times; simply equal parts of sulphur and peroxide of manganese. As to the rods, you have simply to make suitable moulds and pour in the metal.—W. Corry. See the indices of the last three volumes, and read a reply on p. [illegible], Vol. XXXV. There are some directions on p. [illegible], Vol. XXX.—H. [illegible] You may get an idea from p. [illegible], Vol. XXXVI. There are several in back volumes; but for only six eggs at a time, the expense would be out of all proportion.—Climax. Anything that would stop the carbon would require such frequent cleaning as to become a nuisance; but the gas ought to be burnt without making smoke, which is quite an easy matter if the burner and the pressure are properly adapted.—An Amateur [illegible] A simple furnace will be found illustrated on p. [illegible], Vol. XXXIV. Buy the crucible is best, plumbago for preference.—An [illegible] You will find a recipe for koumiss in No. [illegible], p. [illegible], and a great deal about it in back volumes. [illegible] quart of good milk add a tablespoonful of sugar [illegible] of brewers' yeast dissolved in a cupful of boiling water. Mix in a [illegible] warm water a drachm of [illegible] and put all into a champagne bottle; shake, cork, and wire; lay the bottle on its side in a warm [illegible] place. After ten hours shake well, and repeat the process twice a day for, say, 10 days, when the liquid may be withdrawn by means of a champagne tap.—[illegible] You must do it by dipping. Alongside the bath of melted tin have a pot of oil or grease [illegible] Put the cleaned articles in that [illegible] and then pass them through the tin bath, [illegible] with a layer of grease to prevent waste [illegible] with a wisp of hemp, and polish with [illegible] [illegible] slowly. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]—[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] it is not necessary to make two [illegible] [illegible] [illegible] ready [illegible] [illegible] [illegible]—S. H. [illegible] [illegible] [illegible] of the water in the well the syphon will answer if properly constructed; but as the difference is so small it would be advisable to depend on a pump.—J. W. See the indices, or list of Back Numbers last week. You are apparently confusing an induction coil and a medical [illegible] if the wire is really as thick as you say, it is very much too thick. Use about three-quarters of a pound of No. 22, and don't trouble yourself with a primary.—D. Brown and Son. Iron is cheapest for such work; but as the quantity is small only, it would be advisable to use copper. Leads suitable for electric lighting would be much larger than is necessary for bells; but the size would depend on the work to be done. No. 20 B. W. G. is a good size for bells, alarms, &c.—A Fellow Workman. See pp. 102, 174, Vol. XXXV., and the indices of recent volumes. 2. The materials must be given before the "best cement" can be specified. See p. 10, Vol. XXIX., for a useful list, and almost any back volume for something suitable.—Tavistock. You will find a good deal as to the experiments and coils in back numbers. Two coils of about the size named in No. 865.—Wm. Hosken. Will 25d. 7h. 46m. be near enough for your purpose? 2. 13·3 cubic feet per pound. There is only one sort of hydrogen; carburetted hydrogen is a different thing, and is usually called coal-gas.—J. H. D. There is no secret about it, as it was used years ago for making stereotype plates. The moulds must be well baked, and it is better to immerse the mould face down in a pot of metal, tilting it so that the air can escape. See article "Stereotyping" in almost any cyclopædia.—Charles J. Wood. Dutch liquid is a heavy oily liquid, produced by mixing equal volumes of olefiant gas and chlorine, and leaving them to condense over water. The others are purely technical terms, the exact meaning of which can be ascertained only from the firms using them. The term "pressed" no doubt means drawn or hardened, and "annealed" would mean that the brittleness had been taken out after the drawing or hardening process. If you had given us the context of the terms, we might have been able to answer in a more definite manner.—Amateur Photo. Your apparatus is at fault. The simplest way is to take the photo. off the mount, use that to produce a negative by printing in the usual way, and then use negative to make copies. For other methods, and also for enlarging, see indices.—J. C., Whitehaven. We stated on p. 25 that the price of the new Patents Act was 1s. 1½d., 1s. 3d. post free, and it can be obtained from the Queen's Printers, East Harding-street, E.C.—Bernard. De la Rue and Co., Bunhill-row, E.C., publish it, but we forget the price. You should try Clerk-Maxwell's treatise, published by the Clarendon Press, 7, Paternoster-row.—Electric. No book of the kind, at that or any other price. See the indices of back volumes.—A. Bentley. Yes, certainly; because it is a hydrocarbon $C_{10}H_{16}O$. It is very generally used for brightening the flame in magic-lantern lamps. To obtain the best results, the camphor should be previously pounded with a little alcohol in a mortar, and added in the proportion of about two ounces to the pint of colza or sperm; but less for paraffin or crystal oil.—[illegible] We do not know such a cell. The chloride of silver cell has been frequently described.—A. B. C. Yes; by covering the hole from which the wind issues with a valve hinged at one end, and with a wire and a weight at the other. But to do this properly a valve-board is required, which is certainly not in the instrument, or the stops would have been added. For sketch, see p. 33, Vol. XXI.—Whitesmith Man. It is Dutch metal; but see reply 52268, p. 312, last week.—Harry Davis. Several methods have been described in recent volumes; but you might find something suitable in Mr. Fletcher's catalogue, Museum-street, Warrington. How would that on p. 44, this volume, suit?—Amateur Gilder. You must have a strong cyanide solution, and a powerful current. We suppose those in the trade use a bath which has been employed for gilding copper articles. See [illegible] "Goldsmith's Handbook," Lockwood and Co.—G. T. There is no such book. The information required must be sought out from articles and papers such as have appeared in back numbers.—Zat. We have already given it. The larger the motor the better the return. We suspect the 80 per cent. is the useful return of the energy put into a dynamo by a steam-engine. Although some elaborate experiments carried out in America gave 90 per cent. in a motor, there is not much hope of such a return from small machines.—E. P. Asphaltum or lampblack in oil of lavender, or ivory black, wax, and turpentine. Or some use a black enamel, which fuses at a lower temperature than the white.—[illegible] Reader. No. [illegible] [illegible] [illegible] Answered many times; see pp. [illegible], Vol. XXXV.—A New Reader. Ure's book on coins may give you some hints, but you would find a number of suggestions in back volumes.—Iris. You want a perpetual almanac. See pp. [illegible], Vol. XXXVI. There is also a table in [illegible] [illegible] September [illegible] [illegible] was Monday.—Dearness. Is there anything [illegible] in recent numbers? What about [illegible]—W. [illegible] We do not know of any other work on the subject. 2. We doubt if they have "adopted" any brake definitely—[illegible] wants timing and regulating, and compensating. See a number of articles and papers in back volumes.—[illegible] We must decline to insert either. You say nothing about previous statements which other correspondents—and it appears in one instance, at any rate, correctly—have accused you of making, which are not to be reconciled with those you now make. We have very little space to spare just now, and we think our readers have almost had enough of the brake question.—British [illegible] [illegible] foreign [illegible] offers, and you would only get [illegible] which we have no room, neither have we [illegible]—except in rare cases—for problems.—[illegible] You and your friend are disputing a question which has puzzled philosophers in all ages, and is likely to do so. Greater poets than Dr. Young have taken your side—naturally; but it has its difficulties when you think over the matter carefully. Probably in this world we never shall know which opinion is correct.—C. [illegible] Torquay. We gave an account of it on p. [illegible], Vol. XXXVI. We fear you will not abandon the steam-engine just yet—at any rate, in favour of this motor. The daily paper mentioned has shown a curious capacity for publishing details of new and marvellous inventions.—[illegible] All raffles are illegal.—J. D. M[illegible] You are very kind indeed—not that you are alone; another correspondent, to whom we replied on p. 232, made a similar flattering proposal to inaugurate a testimonial for our benefit; but we really feel the obligation rests the other way. We are so entirely indebted to our correspondents for the position to which "ours" has attained, and so conscious how inadequately we use the resources placed at our disposal for the common good, that we wonder sometimes we do not get reproaches instead of congratulations. All we can say is, the most grateful return that we can receive from any reader is help in making "ours" more widely known. If every subscriber brought us another within the next month, we should commence the year with twice our present opportunities of being useful.—Samuel Kershaw. [illegible] a solicitor; as far as we can gather from your statement, you are not entitled to inherit.—[illegible]—Full particulars in Vol. XXVII. Cannot help you unless we know what is the difficulty.—[illegible] F. Wilkinson. In type.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Eithyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXV.—By J. Pierce.

Black.



White. [8—5]

White to play and mate in two moves.

Solution to 862.

White.	Black.
1. Q-Q B 7	1. Kt [illegible] B [illegible]—Q 5 (a) or K takes Kt
2. Q takes P at Q 5	2. Anything
3. Mates	
	(a) 1. Kt takes Q
2. Kt (K B 5)-K 7	2. Anything
3. R or B mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 861 by F. F. Indiake; to 862 by Rev. W. Anderson.

E. Stanley Fairbairn.—There is no mate in your solution if after 1. $\frac{\text{[illegible]}}{\text{Q Kt 4}}$ 2. $\frac{\text{Q-Q B 5}}{\text{Kt-K B 4}}$

M. Graham.—The omission was set right in the last number.

Problems and games received with thanks from F. O'N. Hopkins, J. Russell, and W. T. Pierce.

Mr. J. [illegible], Glasgow, has won the first prize (£2) in English Mechanic [illegible] Correspondence Tourney, having won ten games out of eleven. The sole game which he lost was won by Mr. A. E. Studd. We hope shortly to be able to publish the names of the winners of the second and third prizes.

Secretaries of Chess Clubs who are interested in playing matches with others at some distance are requested to communicate with Mr. W. R. Bland, Duffield, Derby, as it appears that if united action is not speedily taken, the Railway Companies are likely to withdraw the privilege hitherto accorded to members of Chess Clubs of travelling at pleasure-party rates. Secretaries are requested, when they write, to inclose sixpence in stamps towards defraying expenses.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office, except index numbers, which are 3d. each, or post-free, 3½d.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 21, 1883.

ILLUMINATING GAS FROM MINERAL OILS.

THE announcement that the Commissioners of Northern Lights have given instructions for the erection of mineral-oil gasworks on Ailsa Craig to supply gas for working the fog-signal engines, and also for burning in the "lantern" which is being erected on the rock, is an indication that they, at least, are not satisfied with the electric light as a guide to mariners. There is much diversity of opinion on the matter, and little difficulty in finding a host of experienced navigators who are ready to declare that they prefer the old-fashioned oil-lamps to the electric lights which have been erected on certain parts of the coast. The Trinity House have advisedly moved rather slowly in the matter, and although they have had at least one lighthouse in which electricity has been used for what we may now term many years, and a few others in which it has been tried for longer or shorter periods, they do not exhibit any very ardent desire to forsake the old style. Recent experiments in Ireland have demonstrated the great value of gas for lighthouse purposes; but, unfortunately, lighthouses are not always located in spots where an unlimited supply of coal-gas can be obtained, and it is not, therefore, surprising that the commissioners of Northern Lights, having determined to try gas at Ailsa Craig, should have adopted the system which prepares the gas from one of the paraffin oils, especially as in the circumstances the gas can be manufactured more cheaply than from coal. Dr. Stevenson Macadam, of Edinburgh, has made a large number of experiments with paraffin oils, in order to discover the best means of obtaining a permanent gas from them, and has satisfactorily demonstrated that, properly treated, the shale oils will yield an excellent illuminating gas at a comparatively low cost. In the earlier trials with the paraffin oils, no difficulty was experienced in obtaining a permanent gas; but it was found that if large quantities of gas of high illuminating power and uniform quality were required, much skill in manipulation and great attention to details were necessary. Not only did the results vary with the chemical composition of the paraffin oils, but they also varied with the heat employed in gasifying the oil. At low heats, it was found that the tendency was to distil oil rather than permanent gas, whilst at high heats there was much risk of decarburising the oil and gas, and obtaining a product of weak illuminating power. At last, however, suitable heats were discovered, and when the proper quality of oil to give the best results was found, a permanent gas of high illuminating power was obtained with only a small quantity of tarry matter and a slight amount of deposited soot. The paraffin oils employed in Dr. Macadam's experiments are technically known as crude, green, and blue, the first-named being the oil which is obtained direct from the destructive distillation of shale, and which necessarily varies in quality. The green oil is obtained by re-distilling the crude oil, and removing the lighter constituents by fractional distillation; the blue oil is the product of a rectifying and freezing process, in which the green oil is treated with sulphuric acid and soda, the spirit, burning, and intermediate oil being distilled off, and the solid paraffin or wax removed by freezing. By this means three fairly definite paraffin oils were obtained, and after a number of experiments, Dr. Macadam found the best results by running the oil in a thin stream into a retort kept at a bright cherry-red heat. The crude oil has a specific gravity of 850, a flashing point in the close tester of 92° Fahr., and a permanent firing point of 106° Fahr. Its cost is, or was at the time of the experiments, 4½d. per gallon; but its low flashing point rendered it a dangerous oil to store for the production of gas. The green oil has a specific gravity of 884, a flashing point of 165° Fahr., and a permanent firing point of 193° Fahr. This oil is practically safe under any ordinary conditions of working, and yields about 3·80 per cent. more gas per gallon of oil than is obtained from the crude product, but slightly less when the oils are measured by weight. Its price is 5d. per gallon; but as it gives about 5½ per cent. more light value when measured by weight, the figures come out as 3·79 and 3·74 respectively for crude and green oil, when reduced to the light-value unit of a pennyworth of oil. Taking into consideration the safety of the green oil, it is clear that it is much superior to the crude oil. The blue oil has a specific gravity of 878, a flashing point of 163° Fahr., and a permanent firing point of 268° Fahr. Its cost, however, is 7d. a gallon, and its value reduced to the penny unit, only 3·38. Still, it yields the largest quantity of gas from a gallon—a consideration in storage calculation—and is practically free from any risk which attends the use of oils containing the lighter components of the crude material. Tested by a Bunsen photometer the gas yielded by the blue oil gives 54·28 standard sperm candles on a consumption of five cubic feet of gas, and a gallon of the oil yields 127·42 cubic feet. One gallon of the crude oil yields 98·76 cubic feet of gas of 50·36 candles, and a gallon of green oil yields 102·52 cubic feet of 53·24 candles. The cost of the gas from the blue paraffin oil is about 10 per cent. more than that from the crude oil, but against that has to be set perfect safety as compared with considerable risk, and smaller storage space required for a given quantity of gas-making material. A special blue oil sold at the same price as the other—viz., 7d. a gallon, gave still higher figures for illuminating power and quantity of gas per gallon of oil, with the special advantages of remaining liquid at any ordinary temperature, and of being capable of safe storage under any natural conditions, for the flashing point is 270° and the permanent firing point as high as 335° Fahr. Some experiments were made by Dr. Macadam with other illuminants, including a rectified coal oil, which, however, gave the lowest results of any, and demonstrated the fact that the coal naphthas cannot compete with the paraffin oils in yielding large quantities of rich illuminating gas.

It will have been noticed, from the figures given above, that the gas obtained from the paraffin oils has a very much higher illuminating power than that of gas obtained from Boghead cannel (40 candles), and about from three to four times that of the coal gas supplied in London and many places in the provinces; hence, so to speak, a given number of "candles" can be stored in a comparatively small space—as, in fact, has been done with the oil gas used for lighting railway carriages, which appears quite able to hold its own against the electric systems. Obviously, however, if the paraffin oils give so much light in the shape of gas, they will give more if consumed in the liquid state and to ascertain the exact proportion as near as possible, Dr. Macadam made some of his most interesting experiments with common lamps, a gallon of the ordinary paraffin oil (burning oil) yielded a light equal to 22lb. of sperm in standard candles (a standard candle burns 120 grains per hour); and in a Doty lamp it gave a light equal to fully 27lb. of sperm. Since those experiments were made lamps have been improved, and there is now no difficulty in obtaining a lamp—one with an inch and a quarter flat wick—which will give a light equal to the 27lb. of sperm from one gallon of refined oil. Dr. Macadam estimates the crude paraffin oil to be worth three-fourths of the value of the refined oil, and the green oil as equal to four-fifths, which give, when compared with the light-value of the gas produced by both, 80 per cent. of the light-value of the oils. The loss is a trifle less in the case of the blue oil; but taking it at 20 per cent. all round, the question arises whether it is worth while to lose 20 per cent. of the light-giving capacity of the oil in order to grasp the advantages offered by the gas. It must be remembered that the loss of light power is only on the total quantity of oil consumed—that is, more oil is needed to give the same number of candle-hours when it is used in the form of gas than when burnt as oil in lamps provided with wicks. The actual photometric value of the gas is higher than can be obtained from the oil in practice, unless very great attention is paid to the wicks, which would require frequent renewal. There is, too, a limit to the wick area which can be used in any given lamp, and certainly a considerable expenditure of labour in trimming, cleaning, &c., besides loss from breakage of chimneys. Taking all these points into consideration, it seems to follow that there are many places where it would be advisable to convert the oil into gas, especially as it can then be used as required for obtaining motive-power by means of gas-engines, and also for illuminating purposes. Where coal-gas can be obtained at any reasonable price, say, 4s. per 1,000 cubic feet, the oil-gas has no standing; but considering how easily it is made (the retort can be kept at work for days together with the minimum of attention, for the oil is simply allowed to trickle in continuously), its high photometric power (at least 50 candles), and the small space occupied by the required plant, oil-gas is especially adapted for lighthouse work and for use at country mansions. Where the gas is required for motive power (it is used at some lighthouses in the engines employed to work the foghorns), it would be advisable to add to the plant an arrangement for producing water-gas by driving steam over red-hot coke. The carbonic oxide and hydrogen thus obtained might be mixed with the oil-gas to reduce its illuminating power (it is too rich for burning at ordinary gas jets, except No. 1), and to increase the explosive power when used in engines. In districts where coal is found on the spot, or can be had at a cheap rate, oil-gas is economical only for lighting; but in that direction it seems likely to hold its own against the electric light, especially in railway carriages, lighthouses, and other places which cannot be directly connected to large gasworks by fixed piping. If a simple portable apparatus were devised, in which the gas could be made and used at once, it would, we think, find a ready sale: but to be complete, it would be necessary to use oil for heating the retort, and it must, above all things, be free from any risk of explosion. Something of the kind is available for use with gasoline and benzoline; but there can be no doubt that the green or blue paraffin oils would be preferred to the more volatile hydrocarbons.

PATTERN MAKING.—XIX.

Columns and Pipes.

TAKE it a rule to joint all columns and pipes, whether they be small or large. It prevents the tearing away of the upper half of the mould, and the joint forms a convenient basis for the marking of centre and parallel lines, the setting square of blocks, facings, flanges, bosses, &c. Pipes and pillars up to seven or eight inches in diameter will be made of solid stuff; if over those sizes they should be "lagged up." Fig. 1, Vol. XXXVII. p. 449. The transverse blocks or bars upon which the lagging is to be laid may be about 12in. or 15in. apart, and each bar should have a dowel in the centre. The number of pieces of lagging to the circle will vary with the diameter of the pipe or column. An 8in. pipe may have eight strips to the circle, while a column of 16in. or 18in. diameter may have a dozen. Fit the strips and glue successively in the manner described when treating of engine cylinders, the only difference being that a long joint is not made to fit close so readily as a short one. When built up, secure the two halves of the pattern with centre-plates, and put into the lathe. If the pipe be long, staple the joint at intervals before attempting to turn. Do not turn any one portion to finished sizes immediately, but rough the whole pipe down from end to end first. If other work can be prepared in the interval, it is even better to let it remain thus roughed down for a few hours before finishing, than to finish at once. The reason is, that all timber, whether well seasoned or not, has a tendency to spring, and will in most cases buckle more or less out of its original shape when newly-cut grain is exposed to the air. For this reason a careful workman, when beginning a lengthy job, always "gets out" as much stuff as he can see his way clear to get out, and "jacks" it all over before planing or turning any one portion to its finished dimensions.

If the column or pipe be of small diameter in proportion to its length, it will vibrate or "wobble," to use a workman's term, in the lathe, so that to turn it true will be impossible. Make a steady, shaped roughly to fit the bed of the lathe, and to take the diameter of the pipe. The sketch, Fig. 101, shows the best way to make a steady. By means of the sliding blocks A A, replaceable at pleasure with blocks of any other dimensions within the limits of the Vee'd portion of the steady, we can make it a standard tool for pipes of various dimensions. Wedge-shaped cottars, B B, will hold it firmly in position. A lubricant must be applied where the pipe runs in the steady, else much heat will be developed, and an excessive amount of friction be set up. Soft soap, or soft soap mixed with blacklead, are good lubricants.

It will facilitate the turning operation if, in a long pipe, after having reduced the two ends to the required diameter, we plane a straight flat along the pipe from one of the finished ends to the other. We can then see at a glance, when working at any portion of the pipe, whether we are nearly or quite down to the size, without having recourse to callipers and straightedge continually.

Flanges round, square, or of other shapes, socketed or spigoted ends, belts, mouldings, &c., will be required for pipes and columns. If the pipe is to be flanged, the flanges will be made distinct from the body of the pattern. A flange will be made in halves, dowelled together; and where it is put on at the end of a pipe, the hole must be made of such a size that it shall drop into a groove somewhat smaller than the print, to keep it steady. If the print at the end of the pipe is, say, 4in., the groove may be 3½in. in diameter, Fig. 102. The stuff should be got out thicker than the actual thickness of the flange, to allow of a small radius or hollow being turned out at the back. If the casting is to be faced, ⅛in. must be added to the thickness on the front side of the flange on that account. If the flange is to go on some part of the pipe intermediate from the ends, it is usual to turn it as a "body flange"—viz., a flange having a hole of the same diameter as the *outside* of the pipe, Fig. 103. The flange can then be slid along and screwed to any desired position, and the casting can be "stopped off" to the corresponding length. In body flanges the hollow on the back is omitted, being left for the moulder to rub in sand.

For socket and spigot pipes, or faucet and spigot, as they are called also, the pattern may have blocks glued upon it just where the socket is required, large enough to bring it up to the proper size, and long enough to include the socket print which, of course, will be larger than the outside of the pipe by the allowance for "caulking." This method of blocking up the pattern with a permanent socket, though right *enough for standard work,* would be absurd in a jobbing shop where pipes of all lengths and of both kinds are made from a single 9ft. length of pattern. We must have the socket, like the body flange, a thing quite distinct from the pattern, to be screwed on anywhere or removed at pleasure. The most convenient form is an iron pattern socket in halves fitting over the body of the pipe, and cast very thin to reduce its weight. A single screw run in from the top holds it in position (Fig. 104); dotted lines indicate how the socket is lightened out. For the spigot a bead of lead may be cast, bent round, and tacked to the pattern, or, if for permanent use, it may be turned out of the solid.

If round or square holes are wanted in flanges they should be put in by templet—in this case a piece of thin wood cut to the shape of a half flange and having slot holes cut out,—the termination of which gives size and position of cores. The cores rubbed to the thickness of flanges are thrust into position by the templet, and the slight friction of their faces against the faces of the mould is sufficient to retain them in place during the inflow of the metal (Figs. 105—106.

Pipe patterns from which a large number of castings are required are always made in wood or (where the quantity is very large) in iron. Yet we sometimes have pipes of a large size to make where the number of castings is not sufficient to pay for the cost of a pattern. In that case, we make a loam pattern. That is a different thing from a loam mould. In the latter case our boards are made to strike the actual *mould* (Art XI. p. 497 Vol. XXXVII.) In the former, the boards strike up the *pattern* from which the mould is to be made. The flanges will not be struck up but made in wood; unless, indeed, they happen to project only a little distance from the pipe body. Mouldings and sockets, however, will be struck as part of the loam pattern. The annexed figures, 107, wil sufficiently illustrate the way in which a loan pattern and its core are struck up, without verba explanation. We shall return to the subject o loam patterns again in connection with some mor elaborate forms of work.

Branch pipes, fitted to a main piece of pipe might have their ends struck out geometrically but we can always, or almost always, chalk th main pipe and cut the branch to a fit in less tim than would be occupied in striking the neces sary lines. Where branch and pipe, however are of the same diameter, there is a ready and simple method of insuring a fit at once Having marked in the joint of the branc the line where it abuts the edge of the pipe, Fig 107; on this, as a base line, construct a triangle whose sides shall be inclined towards it at a angle of 45°, meeting consequently and formin the apex at the centre line of the pipe, Fig. 108 Cut to these lines at right angles with th joint.

Where the cut faces intersect the circumferenc of the branch a curve will result, which if worke to will insure the required fit without furthe trouble (Fig 109).

Fig. 110 shows a tee pipe, or tee piece, mad in the usual way, with a wide throat at the poin of junction, for the purpose of allowing freedo of water way and diminishing friction. Here special core box (Fig. 111) is advisable, to get th throat of the correct shape corresponding wit the pipe. The core for the pipe, being plain an circular, can be struck up separately, and th branch core butted against it in the moul These throat core boxes are made for vario sized pipes, and kept in the pattern stores read for use.

(*To be continued.*)

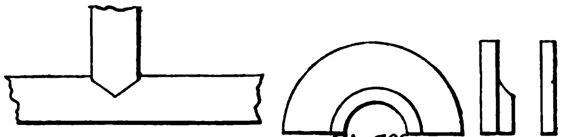


Fig. 102.

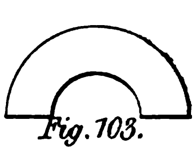
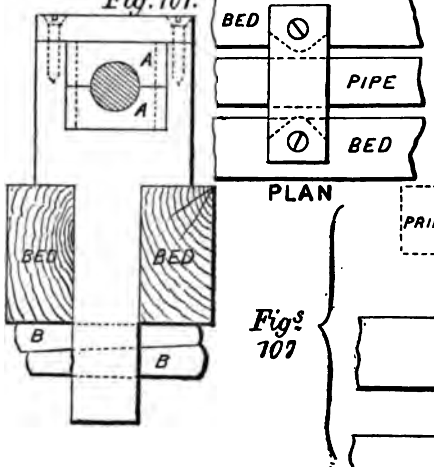
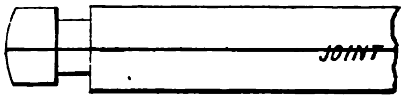
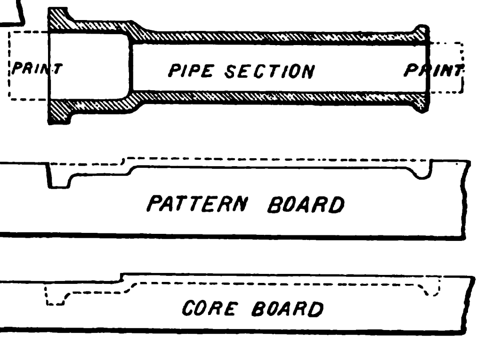


Fig. 103.

Fig. 101.







Figs 107

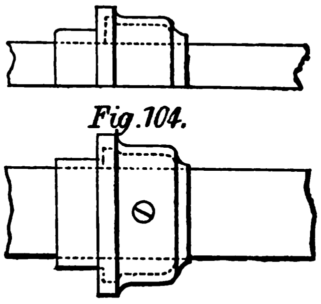


Fig. 104.

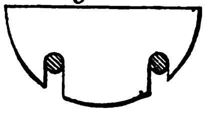


Fig. 105.

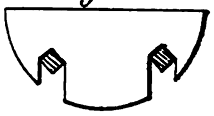


Fig. 106.

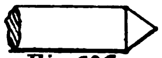


Fig. 107.

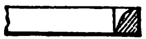


Fig. 108.

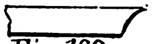


Fig. 109.

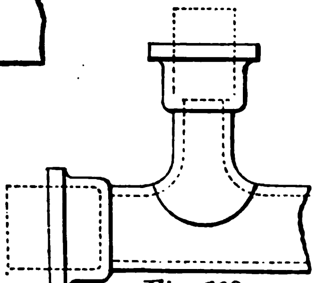


Fig. 110.

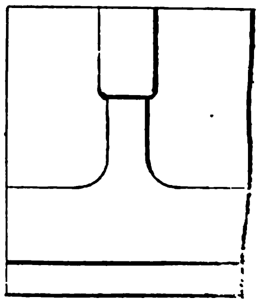


Fig. 111.

PRACTICAL NOTES ON PLUMBING.—LXXXVII.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from p.* 298.)

Measuring for Lead Gutters (*continued*).

SO far let us suppose all to be done, and ready for bossing, or working up the corners, which is done as follows:—"Take the mallet M (or some plumbers use the dummy; I use the first to hand) and bossing stick R, and having the lead with its corners cut off, as illustrated at Fig. 408, and trued up shipshape, proceed as follows: First let the mate hold the lead nice and firm, to prevent it swaying about. The best plan to do this is for him to kneel at about the figures 1882, then place the other knee at 18, and with his fingers put round the edge of the lead, let him pull it towards his knee; this will hold it as firm as a rock, and the plumber can work with ease as follows: Place the mallet as shown, and with the bossing stick work the lead from the corner steadily and regularly upwards. The mallet is to keep the lead to its shape *regularly round*. When learning, you must proceed in this work very steadily, and not want to do it all at once. Keep working it upwards, but not too much so as to weaken it (or to cause the end *a* to become rounded or out of the square); but if anything rather let it thicken. Keep at it, and do not forget to keep it well round until it is near about high enough; then you may work it nearly square, and as shown at B 4, R, and at Q, diagram 407. Having bossed up the corners, next let the mate "bash down" the gutter as follows: You take hold of the buckled or puckered up side, as at T, diagram 415, and let your mate throw it down straight, and let him follow it up with his hands to prevent it springing back or from "rounding itself"—that is, by springing up about 1½in. after it was thrown down. If this is allowed to take place, the straightness of the edges cannot be maintained, and will give you extra work when laying it. Now having got so far, next turn the lead on its side, as shown at diagram 416,

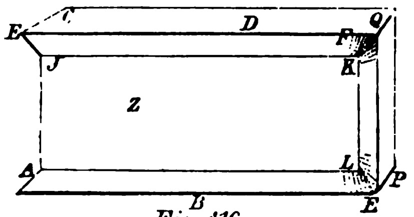


Fig. 416.

and with your dresser and mallet put in the two stiffening lines A L and J K, and with the dresser hollow the centre of the gutter up as shown; then dress up the arris E F to a true line. After this, lay the gutter gently down as at diagrams 417 and 418, and it is now ready for "putting in," excepting the putting in of the four hand holes on the turn-up edges, which is done by bending the turn edge of the lead over on the *inside* of the gutter, as illustrated at two drip end hand holes K and F, diagram 419. This allows you to grip the gutter firmly when lifting it into its place. The hand holes will be best placed, say, for a 10ft. gutter, 2ft. from each end. Now see that the joint in brickwork, as shown at A R, Fig. 410, is properly raked out to a depth of at least 1¼in., 1½in. would be better. Now sweep the gutter thoroughly clean out, so as to have no small pieces of stone or other hard substances in the gutter; also see that the nail heads are thoroughly punched home, and proceed to put in your first gutter, which, if a wide one, should have a piece of quartering Q (Figs. 417 and 418) laid in the centre, so that the middle of the gutter will be kept up, and thus better allow the arrises of the gutter to take a bearing on the gutter-board. Now, having the gutter properly prepared and lifted into its place, let the mate now with his holding-down stick hold down the corner of the gutter at S, Fig. 418, and as at S, Fig. 412. Put the end of your dresser on this corner, part on the end and part on the side, turn up lead at S (your mate still holding down). With your hammer strike the dresser a heavy blow, which will cause the lead to go well down; if it be the first gutter with a drip, as at Y, Fig. 409, work the drip down as to be hereafter spoken of; but for our purpose let it be the head gutter, as at Fig. 420. If so, then put a nail into the stand-up side at *a*, Fig. 420 (which is an end or overcloak gutter), so as to keep it down. Now with your dresser flatten your stiffening line, and smooth the bottom. Proceed to do the other corner, then go and "work down the drip," which at first will require your particular attention. Proceed as follows:

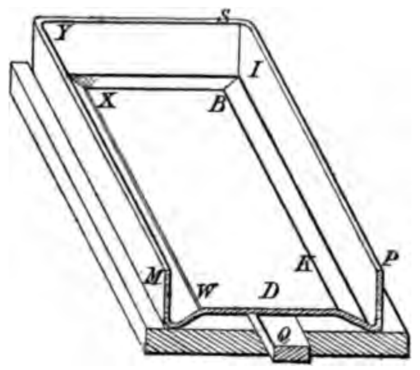


Fig. 417.

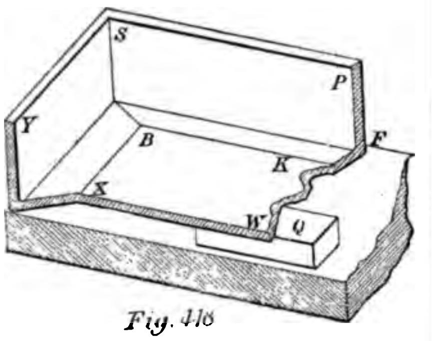


Fig. 418

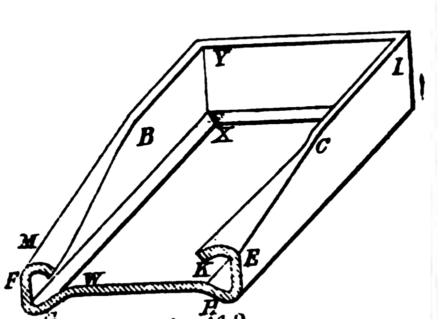


Fig. 419.

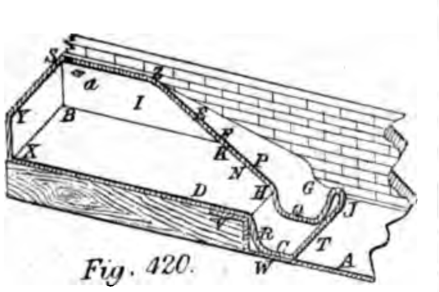


Fig. 420.

First see that no grit is between the under and over cloaks of the lead. Now, with the side of your mallet, or a short piece of roll, knock the lead a little down into the angle towards the drip, as shown at R, diagram 420. Next, from about 3ft. from the drip, bend the stand-up side of the lead down, as shown at Z E F P Q G, and give this a "smack down" also with the side of the mallet, as shown at Q G, but not right back on the arris of the side lead so as to cripple it. Now let the mate, with the holding-down stick placed at Q, hold this lead firmly down, and you with the dummy work the side of the lead up again, beginning at E, and working it regularly along from E to H. This will lengthen the top edge of the lead, and cause it to become rounded (similar to that shown at P G J, diagram 420 *a*). This beating up will allow the corner of the lead to be easily bent down over the end of the drip without too much work afterwards. Having this worked nearly upright, bend it down again, and work it until the top edge is quite rounded, and like that shown at K L, diagram 413. Now proceed to work the lead into the corner of the drip, which is done as follows: Let the mate with his holding-down stick hold the lead firmly down from springing, as shown at W, diagram 421, and you take the hornbeam dresser and mallet at about 5in. from the corner as at N. Knock the lead well back into the angle of the drip, then take a *dull* chasewedge, whose edge is ½in. thick (I like a piece of soft wood instead of boxwood) as at M, diagram 407, and with it work the lead into a kind of bulged bag, so as to get surplus lead in order that it may be worked into the corner G (Fig. 413) without straining it. The beforementioned bulged bag is well shown at P Q in diagram 427. It is formed by carefully and regularly working all the outer parts equally towards the centre, and without straining the lead more in one part than another. Do it regularly, and in such a manner that the lead shall be as thick in the angle as in the other parts. Keep at this until it is properly down, as at C G diagram 413. It will be then well to tack it down as shown at F E, or by sticking a 4in. nail, or better, a wall hook, through the two leads and into the joint of the brickwork. After you have hooked, nailed, tacked, or otherwise fastened the corner down to prevent it from rising, proceed to work the other side, and having this done, trim the lead so that there may be a 1½in. splash lap left, and as shown in diagram 413. In order that the overcloak shall not rise, put a wall hook, nail, or tack, into the lead, as shown at E F 1 diagram 413; and the drip and gutter may be finished, and ready for putting some boards into, to prevent it being destroyed. I may here mention that most of our lead gutters often get half worn out long before the roof or building is completed, which is due to the fact that the plumber will not look after a few boards to lay in them whilst the slaters, bricklayers, &c., are doing their work. I consider that when gutters are laid, it is the duty of the plumber to see that they are properly protected, more especially as it oftentimes will not cost him a penny to do it.

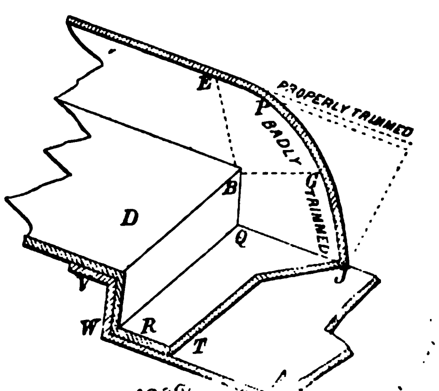


Fig. 420a

(*To be continued.*)

A CHEAP MEAL.

A SUPPER to about 150 people has been given in the Grove-walk Schoolroom, Hoxton-street, Shoreditch, by Dr. T. R. Allinson, under the auspices of the National Food Reform Society, with the object, in the words of the invitation, of proving the tastiness, healthiness, and economy of a non-flesh diet. Those invited were for the most part women attending the mothers' meetings and other religious parish organisations of St. Leonard's, Shoreditch—the society seeking, by the demonstrations they have undertaken, and of which they have already given several in different parts of the metropolis, to appeal through the palate and the stomach to the understanding of the poor, especially of all sections of the labouring classes, and to instruct them in that of which the London working population know less than their fellows in any country—the use and wholesome preparation of vegetable food. The bill of fare comprised three course—Scotch broth and a slice of whole meal bread: for a savoury dish, green pea pie with potatoes, the pie crust being made with vegetable oil: and for desert, sweetened semolina and stewed prunes. Mr. F. P. Doremus, hon. secretary of the society, addressing those present after the cloth had been drawn, said that as they had all apparently enjoyed their supper they might, as mothers of families, like to know something about its ingredients and preparation. The cook told him that in making the soup there were used, for every gallon of water, four ounces of pearl barley, one turnip, one carrot, two ounces of groats, pepper, salt, &c., to taste; in the green pea pie the contents were peas, a hard-boiled egg, tapioca, and mint to flavour; for the dessert, one pound of semolina to the gallon of water, with sugar to sweeten, served with stewed prunes. After exhibiting some coloured diagrams to show graphically the relative quantities of water, muscle-forming, bone-forming, and heat-giving constituents of whole-meal bread, oatmeal, and beef, he remarked that they would see by the difference in the proportions of these substances that in a pound of butcher's meat 12oz. represented the water present, for which they were paying at the rate of 9d. to 1s. a pound; while in the peas they got from the corn-chandler, for instance, the water was a very small part of the whole, and they could from the cistern get for little or nothing the water it was necessary to add. Thus, again, when they bought haricot beans they obtained for 2d. or 3d. 14oz. of solid food instead of the four ounces contained in the pound of flesh meat they had to pay a 1s. for. Pointing to the Scotch gillies and oatmeal-and-brose-fed men who formed the pride of our Highland regiments as specimens of a manhood to which the bone and sinew had been given by a vegetable diet, he instanced his personal experience of four or five years in favour of the sufficiency, wholesomeness, and superiority of a dietary into which flesh, whether of mammal, bird, or fish, never entered. This society did not, like some philanthropists, recommend what the members did not themselves adopt; they practised what they preached. It might surprise some of those present to learn that the whole cost of the food supplied to each person there was 3d. for the supper. Another view of the matter was that the misery of which they had too much in London was not only due to the high price of provisions, but very greatly to the want of work. If people would give up flesh-eating, one effect would be to bring under cultivation nearly all the acres of land in the country, either for the growing of grain or as market gardens; and it should be remembered that every million quarters of wheat raised in these islands gave employment to 16,000 people, while the same land devoted to cattle raising would not find work for one-sixth that number of hands. This calculation took no account of the increased requirements of the milling, baking, and other trades to which a stimulus would be given. Dr. Allinson spoke on the relative values of farinaceous and other vegetable foods compared with meat. The company being invited to declare, by show of hands, if they felt satisfied with the supper, the response was unanimously in the affirmative.

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COUGHS.

It is sometimes forgotten that *coughs*—properly so-called and in their integrity—are convulsive, expiratory efforts intended to eject from the air-cells or passages of the lungs, or from the windpipe or larynx, either secretions or exudations, or occasionally foreign substances, which impede the act of respiration. Unfortunately there is seldom any constant relation between the frequency and force of a cough and the physical need for it. This is because, the act being, of course, performed by virtue of a special excitation of the nervous system, the degree of excitability of the nerves concerned in the production of the muscular contractions producing cough determines its force and frequency, instead of their being governed, as they ought to be, solely by the exigencies of expulsion. Moreover, owing to the sympathetic connection of nerves energising different groups of muscles and in relation with different centres, cough may be produced by excitations which are not local to the breathing organs. Therefore we find that *cough*, which ought to be a very simple process or function of a remedial, or, at least, physically helpful kind, is, in fact, itself a cause of disturbance and disease by reason of its excessive and disorderly character. Very grave mistakes are made in practice by treating cough as a pulmonary affection and in itself morbid. It is in a very large proportion extra-pulmonary in its cause, and it is only morbid in itself when there is no disease or disturbance in the lung which can create a need for expulsive efforts. Cough is always a nervously induced phenomenon, and as such it ought to be treated with the utmost carefulness, so as to ascertain its cause, its *raison d'être*, and the proportional relation which subsists between need and effort where need really exists. Without clear views on these various aspects of the question of cough in each particular case, it cannot be intelligently treated.—*Lancet*.

THE LATE ROBERT B. TOLLES.

The death is announced of Mr. Robert B. Tolles, optician, of Boston, U.S.A. During several years past he devoted himself to the improvement of the microscope, and to the production of telescopes of unusually short focus, and his work was characterised by great originality and excellence. He was one of the first opticians in America to construct object-glasses for the microscope on Amici's immersion system, and he succeeded in developing several original formulæ by which he extended the apertures far beyond the limit previously attained in either Europe or America. One of the earliest examples of his work seen in this country was a one-sixth water-immersion object-glass, now in the possession of Mr. Frank Crisp, Secretary of the Royal Microscopical Society, and which was the subject of much discussion in journals devoted to microscopy. Mr. Tolles claimed for this object-glass an aperture which was generally regarded as impossibly large. After much controversy, he had the satisfaction of receiving the support of Prof. G. G. Stokes, Secretary of the Royal Society, Prof. S. Newcomb, Director of the Washington Observatory, and Prof. E. Abbe, of Jena University, for the general accuracy of his views. He was an enthusiast in his work, and was almost incessantly engaged in making experimental object-glasses both for the microscope and telescope, many of which exhibited rare qualities, and were eagerly sought for by amateurs of fine work. He made the highest power microscope object-glass produced in America, a water-immersion of 1/75in. in focal length. One of his latest and most successful telescopes was a 5½in. portable equatorial of very short focus for Prof. Hamilton L. Smith, of Harvard University, who has published his trials of the instrument, proving it to be of exceptionally fine quality. The numerous improvements devised by Mr. Tolles in the construction of the microscope have done much to place American optical workmanship on a par with the best in Europe.

Critical Point of Liquefiable Gases.—A Paper appears in the *Journal de Physique*, by M. J. Jamin, on the "Critical Point of Liquefiable Gases," in which he discusses a new theory. He says:—"I believe that gases are liquefiable at all temperatures when the pressure is sufficient." Describing Cagniard de la Tour's experiment, he says: "According to known laws, the quantity of vapour above the liquid increases very rapidly, its density increasing at the same rate as its weight without known limit. Again, the remaining portion of the liquid expands at an increasing rate until it passes that of the gas (Thilorier): it is clear, then, by the effect of these inverse variations, that at last a limiting temperature must be reached when the liquid and the vapour must have the same weight for the same volume. At this point they are inseparable: the vapour does not rise nor the liquid fall, and the surface of the liquid disappears." Thus, the critical point is the temperature when a liquid and its saturated vapour have the same density. From the experiments of Cagniard de la Tour he deduces that at the critical point a liquid has no latent heat, and in summing up he says: "At the critical point there is no difference between a liquid and its vapour, neither in tension, nor density, nor thermal constitution, nor appearance, nor any property by which they can be distinguished."

Luminous Jewels.—M. Gaston Trouvé, the well-known electrician, of Paris, has lately designed a series of ornaments for ladies' wear, which consist of glass, coloured and cut to imitate rubies, diamonds, &c., fitted in an envelope, surrounding a small incandescent lamp of low resistance. The light shines through the pieces of glass only, and gives them all the appearance of the stone they are intended to imitate. The lamp is fed from a small battery, which is carried about the person. It is composed of three pairs of zinc-carbon plates (two carbons to each zinc), or a larger number according to the current required. These plates dip in a saturated solution of bichromate of potash, which is contained by an ebonite cell with three compartments. The plates are fitted into a cover, which is kept securely down on the top of the cell by two bands of indiarubber passed round the whole. Finally the battery is encased in two sheets of gutta-percha, so as to entirely prevent any leakage. A miniature switch is carried in the pocket or elsewhere within reach, to which the battery and lamp wires are connected. The pressure of a finger on the arm of this switch makes or breaks communication with the lamp. The battery weighs (with six plates) 300 grammes, and will work about 30 minutes with a two to three volt-lamp. A larger battery to work a four or eight-volt lamp weighs 800 grammes.—*Electricien*.

SCIENTIFIC SOCIETIES.

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ROYAL ASTRONOMICAL SOCIETY.

The second meeting after the long vacation was held at the Society's rooms, Burlington House, on the evening of Friday, Dec. 14th. Mr. E. J. Stone, president, in the chair.

Mr. Ranyard read a note on a narrow belt which he had seen on the planet Saturn. He said that he believed narrow belts similar to those seen upon Jupiter were very rare. There were many observations of broad belts of a bluish-brown colour upon the ball of the planet; but he was not aware of any other observation of a sharply defined narrow belt. While observing the planet on the evening of the 4th Nov., with an 15in. silver-on-glass reflector, he noticed a narrow dark belt which stretched across the disc, and at moments of good definition could be seen to fade away towards either limb: but he thought that the decrease in intensity was not as marked as in the case of similar belts upon Jupiter. The colour of the belt was a dark blue-grey, strikingly different from the reddish-brown of the belts upon Jupiter. On the 4th Nov. it was a striking object, nearly as easily seen as the Cassini division on the ring, though not so dark. He estimated its breadth as not double the breadth of the Cassini division, where it is seen broadest in the ansæ. The belt was again seen on the 13th Nov., but it was not then so conspicuous, and the definition was not as good as on the 4th. On the 21st he saw it again, and it was also seen by Mr. Hopkins, who observed it with him. He had tried to find whether any other persons had seen it, and had found that Dr. Copeland had on the 6th Nov. seen a dark belt, which he described as in about 20° south latitude, sharp towards the Equator, and shading off towards the Pole. He estimated its breadth at about twice that of the great division in the ring. It should be remarked that taking ten and a quarter hours as the rotation period of the planet, the opposite side of the ball would have been turned towards the earth at the time of Dr. Copeland's observation as compared with Mr. Ranyard's observations of the 4th and 13th.

Mr. Knobel remarked that the curvature of the belt as shown in Mr. Ranyard's drawing did not appear to correspond with the position of the axis of the planet.

Mr. Ranyard said that he had not given particular attention to the curvature of the belt. His attention had been more particularly directed to the breadth of the belt, the fading off towards the limb, its colour, and the position of the belt upon the planet. Dr. Copeland and Mr. Hopkins gave the position of the belt as a little higher up towards the South Pole than according to his estimate of its position.

Mr. E. J. Stone explained a paper on the supposed possible independence of Bessel's and Le Verrier's expressions for the mean longitude of the sun, subject to the conditions imposed upon them by their use in practical astronomy in the determination of mean solar time. The paper was chiefly in answer to criticisms made by Prof. Adams and Prof. Cayley. He said that Prof. Adams assumes that we have what he calls a mean solar day, just as we have a standard yard kept at Greenwich, which can always be referred to. But this is evidently not the case; the length of the day depends upon the angular velocities of the sun and when a change is made in the theory of the sun's motion, it will necessitate a corresponding change in the length of the mean day.

Prof. Adams said: I am sorry to differ so completely from the President. He has said that the mean sun is an imaginary body. I reply that it is simply the place of the real sun cleared of all periodic inequalities to which the sun's motion is subject. Mean time is simply determined by the transit of that body, supposing it to move in the equator instead of in the ecliptic, and it does not depend on the motion of the sun in longitude. The rate of revolution, by which we count time, is therefore 365 times as rapid as the motion in the longitude which Mr. Stone's reasoning refers to.

The Astronomer Royal read a note entitled "Observations of Comet *b* (1882)" (Pons-Brooks), made at the Royal Observatory, Greenwich. He said that the spectrum of the comet consisted of three bands agreeing with the ordinary spectrum of the Bunsen flame. The bright lines had been traced for a distance of 4′, that is 2′ on either side of the nucleus. There does not appear to be any very decided continuous spectrum except from the nucleus and the parts immediately adjacent to it. The spectroscopic observations have been made by Mr. Maunder.

Mr. Knobel read a paper on the "Rotation Period of Jupiter," in which he showed that there was a difference in the rotation period of the great red spot and the white spot which has been conspicuous for the past year.

Mr. Mattieu Williams read a paper on the recent twilight glows. He said: The idea had occurred to me that the remarkable sunset tints were due to a cloud of meteoric dust, and I was making experiments on that assumption when Mr. Ranyard's article on the subject appeared. I commenced operations by exposing slips of glass, covered with glycerine, in suitable positions to catch the dust. On testing these slips after exposure with acid and ferrocyanide of potassium, I got indications of the presence of iron; but just at that time the snowstorm of the 5th December gave the opportunity of collecting the matter brought down from the air by the snow in greater quantities. The experiments were made at Stonebridge, the wind blowing at the time across the Weald of Harrow, one of the most thinly-populated districts in the neighbourhood of London. In the first instance, an ounce and a half of snow was collected by means of a clean plate of glass. On melting the snow there was a black residue at the bottom of the water; this was collected and found to contain a great quantity of magnetic particles of iron. Mr. Williams showed to the meeting a filter paper covered by a dense blue precipitate, obtained by adding ferro-cyanide of potassium to the sediment from the water derived from the ounce and a half of snow. He had since collected 75oz. of snow, and he showed to the meeting a little bottle containing black sediment derived from the 75oz. It was full of particles which were acted upon by the magnet, and the chemical reactions also showed that the dust was chiefly composed of magnetic oxide of iron. One interesting feature about the ferro-cyanide precipitate is that it exhibits a striking green colour, very different from the blue precipitate obtained from pure iron. He had not yet been able to properly test the question, but he thought that the green colour indicated the presence of nickel. Mr. Williams suggested that similar observations should be made on Ben Nevis. It was important to determine what was the matter ordinarily brought down in snow, and whether there was any great change at the present time: such an examination of the materials brought down by snow ought to be part of the routine work of mountain observatories.

Mr. Knobel asked why Mr. Williams attached such importance to the presence of nickel. He had not mentioned what was the additional evidence of its presence besides the green colour of the precipitate.

Mr. Williams said that the importance of determining the presence of nickel turned upon the fact that meteoric iron usually contains nickel, whereas, terrestrial iron does not. There was another indication of the presence of nickel beside the green colour. Cyanide of potassium in excess absorbs cyanide of nickel, and he had found that this held good with the snow precipitate, but he hoped still further to test the matter.

Mr. Ranyard said: Mr. Williams sent me a little of this snow residue, and it seems to be very satisfactorily free from terrestrial dust, for, on adding hydrochloric acid there is no indication of its containing particles of carbonate of lime, and with the wind blowing across the Weald of Harrow there certainly would be such particles, if the snow had contained terrestrial dust. The sediment contains a large number of amorphous grains of black oxide of iron, which, when the dust is placed under the microscope in a drop of glycerine, may be seen to swing as a magnet is moved in the neighbourhood. Such grains of black oxide might be volcanic in their origin—in fact, I have obtained very similar grains from some volcanic dust which fell upon the deck of a man of war out of sight of land in 1812. This dust was sent me by Mr. Symons, who stated that there was an eruption in the Island of St. Vincent about the same time; but the St. Vincent dust does not contain anything like so large a proportion of black oxide, and it does not contain any smaller particles of metallic iron such as I find in Mr. Williams's snow residue, and as I have also found in some snow residue I collected in London. These small particles of metallic iron can be easily recognised by their shape under the microscope, and there is, I think, very strong evidence that they are meteoric in origin. Copper may be thrown down upon them from a solution of sulphate of copper, showing them to be metallic iron. Similar particles have been collected from snow at various times by several observers, and they have been shown to contain nickel-iron, which conclusively points to their meteoric origin. One interesting point in connection with this snow residue is that it is black, or nearly black; whereas the dust which fell in Java after the eruption of Krakatoa made the landscape appear white. I have collected the residue from snow in other years, and have found it to be much lighter than the specimen shown by Mr. Williams. The question of whether the dust brought down by the snow matches with the dust which fell in the Java region is one of considerable interest, with regard to which I hope that there will be further evidence forthcoming. If the dust which caused the blue sun and the sunset phenomena to be seen in the West Indies on the 2nd of September, was derived from Krakatoa, we must believe that it travelled half round the earth at a rate of nearly 200 miles an hour for seven days without producing a cyclone or any exceptional storms at the sea level. One can hardly predict what is possible in nature, but such a state of things seems very improbable at first sight. If the dust which produced the blue-sun phenomena was meteoric, we should expect to find that the phenomena caused by the dust appeared over a whole hemisphere of the earth at about the same time. At present, it has been shown that the phenomena was seen in the West Indies and on the Gold Coast on the 2nd of September, and that the sunsets were seen in Australia on the 10th September, and in Ceylon and India on the 9th September. Light will be thrown on the subject if we can find out when the phenomena began at various stations. I think facts are coming to light which show that the phenomena were not at first equally distributed over a whole hemisphere. I may mention that the dust brought down by the recent snowstorm contains a number of rounded particles of quartz. I have compared them with Egyptian dust and dust blown from the Sahara. The particles in the Egyptian and Sahara dust are, I think, more rounded; but there can be no doubt that there has been some friction going on between the particles that have been brought down to us by the snow. The dust particles carried up from the Sahara are seldom carried as far north as Rome or Naples, and never as far as Paris and London. It seems very difficult to conceive how such large and heavy grains as the black oxide particles contained in the snow residue could have remained in the air for over three months, and be carried as far as from Java to England, which the volcanic theory requires us to suppose.

The Astronomer Royal said: It is a very important point to settle whether this dust has its origin outside the earth, or whether it may be due to local terrestrial causes. I should therefore like to ask Mr. Williams whether there is not any possibility that the iron may have been brought from some furnaces in England. He mentioned that there was a wind blowing from the north-west when the snow fell. Are there any iron furnaces to the north-west of Stonebridge.

Mr. Williams said that no doubt there were such furnaces at a distance of 100 miles away, but it was impossible to believe that such an amount of black oxide could have been derived from them, especially when the specific gravity of the particles was taken into account. They were about four and a half times as heavy as water. He believed that the particles were derived from a great meteoric cloud through which the earth was passing, and through which it had been travelling for the last three months. There is one point to which I should like to draw attention, that is, the fact that there are two distinct sunset glows every evening, one following the other. The first corresponds to the ordinary sunset glow in which the under surfaces of the clouds are lit up by the sun; this dies away, and the clouds are then seen as dark objects floating on a bright background of illuminated matter above them. This shows the great height in the atmosphere at which the dust producing the colours of the second glow is distributed.

Hot Water for Colds.—Dr. George R. Shepherd, Hartford, Conn., says, in respect to the use of hot water as a remedial agent in the treatment of inflammation of the mucous membrances, "I have used hot water as a gargle for the past six or eight years. In acute pharyngitis and tonsillitis, and in coryza, or cold in the head, if properly used in the commencement of the attack, it constitutes one of our most effective remedies, being frequently promptly curative. To be of service it should be used in considerable quantity (a half pint or a pint at a time), and just as hot as the throat will tolerate."

Hudson and Kearns' Diaries.—These diaries are especially designed for engineers, surveyors, architects, and professional men. We always use them ourselves, and are not surprised to hear that the demand yearly increases. The makers are still busy with improvements, especially with regard to the date-indicating diary blotting-pads. No. 8, on which there has been quite a run for the coming year, is made of the finest stout blotting-paper, and the block of plain paper at the right-hand side has been found a most useful addition. No. 4, made in the form of a portfolio, is a pad which seems to be appreciated. Nos. 6 and 7 are the most general pads, being so very cheap. Among the diaries for general use we especially note Nos. 9 and 10 as being very cheap and more complete than in past years. No. 11, especially prepared for builders and those connected with the building trade, contains all the information as in Nos. 9 and 10, and some new tables, &c., at the end. No. 12 and 13, specially prepared for architects, surveyors, and engineers, contain, as heretofore, much information. All the diaries are printed on paper of superior quality, and are strongly bound in cloth gilt.

SCIENTIFIC NEWS.

WE may remind our readers that with the absence of moonlight in the early evening now prevailing, comet Pons-Brooks ought to be picked up with comparative ease. Its approximate position for any day in the month can be found from the table on p. 277; but on Sunday next it will have R.A. 20h. 41m. 54s.; N.P.D. 55° 57′, and be near Epsilon Cygni.

The extraordinary phenomena of the coloured sun and moon have brought forth a number of explanations; but the evidence at present favours the hypothesis that the effects are due to a large quantity of meteoric dust in the atmosphere—at least, several samples of snow which have been gathered yielded considerable amounts of magnetic iron. The dust propelled into the upper regions of the atmosphere by recent volcanic disturbances consists, according to M. Daubree, of colourless crystals of felspar, small black fragments of augite, a large number of transparent crystals of hypersthene, and crystals of magnetite and pyrites. A similar composition of the dust was found by M. Rénard, of Brussels.

In a paper recently read at a meeting of the Physical Society, Professor S. P. Thompson showed that if electricity be considered as a self-repulsive medium, a surplus in one place and a deficit in another would give rise to motion between them, i.e., attraction. Prof. Thompson follows the hypothesis until he infers that electricity is either the ether or other electrified—most probably the former.

In a lecture on "Solar Radiation and Atmospheric Absorption," delivered the other day at Glasgow by Captain W. de W. Abney, the lecturer stated that he had selected that subject because it was not so well understood as it ought to be, and because dark rays had a very marked effect upon the earth's economy, for without those rays the world would be left in perpetual frosts, and would be uninhabitable. He has arrived at the conclusion that the solar temperature is 5,200° C.

At a recent meeting of the London Section of the Society of Chemical Industry, the apparatus invented by Dr. Raydt, of Hanover, for facilitating the utilisation of liquid carbonic acid in breweries and manufactories of aërated beverages, was shown. The pressure required is as much as thirty-six atmospheres, and the liquefied acid is conveyed in strong wrought-iron cylinders fitted with a brass screw valve.

At the Parkes Museum recently, Dr. G. V. Poore lectured on coffee and tea. He expressed the belief that stimulants, both alcoholic and alkaloidal, had their uses, and that we ought to be sure of our ground before we override appetite with dogma. The cup of coffee—genuine, it should be observed—contains more alkaloidal stimulant than a cup of tea, and owing to the absence of tannin, its action is more rapid than that of tea The danger of excessive tea drinking consists mainly in the quantity of astringent matter, which is a prolific source of dyspepsia amongst sedentary workers, especially if they boil the tea. Dr. Poore said that coffee should be fresh roasted and ground, both of which operations ought to be done at home; from one and a half to two ounces is the quantity for a pint of water. When wanted early in the morning, it should be infused in cold water over night and heated to the boiling point, but not to violent ebullition, when required for drinking.

Mr. A. Cowley Malley, of Munslow, Craven Arms, sends us a photograph 8½in. in diameter of a slide of scales of Polyomatus Argus enlarged 750 diameters. The time occupied from the preparation of the slide to the finishing of the print was three hours.

The installation of the electric light amongst some of the shops in the vicinity of Brixton station appears to be one of the most successful, and to give satisfaction all round. The arc lamps used now are those of Clark, Clark, and Bowman, which have a very delicate feed arrangement. The installation extends over a considerable distance, and includes incandescent lamps, and at least one motor, which is used by a grocer for grinding coffee. It is probable that the majority of the tradesmen will adopt the light, as one arc lamp is sufficient to brilliantly illuminate a large shop window, and costs, I believe, a rental of 10s. a week.

At Niblo's Theatre, New York, Edison's incandescent lamps are used in several scenes in "Excelsior": in the last, the dancers are provided with wands having Edison lamps at the ends, while festoons of similar lamps are lowered from the flies. The 400 lamps are rendered incandescent at once, the effect being magical and impressive.

The United States Lighthouse Board intend to erect a tower 250ft. high at Hallet's Point, on which are to be placed six electric lamps of about 4,000 candle-power each. It is expected that the lamps will throw such a flood of light as will render the passage of Hell Gate as safe by night as by day.

The Boston and Albany Railroad is building a compound goods engine, with two large and two small cylinders. The driving wheels will be 54in. in diameter.

Herr Poetsch has invented a method of sinking shafts in watery running ground by first freezing the water, and then working the frozen mass out by hand. The wet ground is frozen by placing pipes in boreholes, and then passing through them a solution of the chlorides of magnesium and calcium, which reduces the temperature to about − 35° C.

The *American Naturalist* says that amongst the discoveries of the U.S. Fish Commission last summer is a deep-sea fish, closely allied to the very strange Eurypharynx dredged last year at the bottom of the Mediterranean. Five specimens were obtained, and a study of the anatomy shows that it presents so many peculiar features as to entitle it to form the type of a new order. Ten new genera and seventeen new species of fishes were collected in addition, besides new molluscs and worms.

USEFUL AND SCIENTIFIC NOTES.

A New Method of Obtaining Pulp.—G. Archbold macerates wood or straw, cut into suitable pieces, in dilute milk of lime, after twelve hours introduces them into a suitable digester, and saturates with sulphurous acid, the pressure amounting to four or five atmospheres. In two hours the material is so loosened up, that after washing with water and further treatment under pressure with 3 per cent. chloride of calcium and half per cent. aluminum sulphate dissolved in a little water, the stuff obtained without any further operation has the appearance of cotton, and can serve for the manufacture of fine qualities of paper.

Coffee and Alcohol in Brazil.—According to the statement of the Vice Director of the Rio Janeiro faculty of medicine, it appears that in Brazil, where great quantities of coffee are used and where all the inhabitants take it many times a day, alcoholism is completely unknown; it is further stated that the immigrants arriving in that country, though beset with the passion for alcohol, contract little by little the habits of the Brazilians, acquiring their fondness for drinking coffee and their aversion for liquors; and as the children of these immigrants brought up with coffee from their early years never contract the fatal habits known to their parents, it would seem that the number of drunkards in the country is in inverse ratio to the amount of coffee consumed. A South American correspondent of the *Medical Times* confirms the above statements, asserting that the number of cafés in the large cities of Brazil—where multitudes of persons from the highest down to the lowest go in to take a cup of that delicious beverage which none but Brazilians know how to make properly—is enormous, while drinking saloons or bars are very few, and their patrons fewer still.

Action of Sunlight on Phosphorous Anhydride.—At a recent meeting of the Chemical Society a paper was read "On the Alleged Decomposition of Phosphorous Anhydride by Sunlight," by Messrs. R. Cowper and V. B. Lewes. In a paper read before the Southport meeting of the British Association by the Rev. A. Irving, the author stated that phosphorous anhydride, prepared by passing a slow stream of dry air over molten phosphorous, decomposed, when exposed to sunlight, into amorphous phosphorus and phosphoric anhydride. The authors have repeated this experiment, and analysed the sublimate obtained in the manner described by Irving—it consisted of 78·2 per cent. of phosphoric anhydride, 4·7 per cent. phosphorous anhydride, and 17 per cent. of phosphorus. On exposing this white mixture to sunlight it became red, the phosphorus being converted into the amorphous variety. In another experiment the air, after passing over the melted phosphorus, bubbled through carbon disulphide. After some time the bisulphide was allowed to evaporate on blotting paper, when enough phosphorus was left behind to give dense fumes.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

REPORT OF THE O'GYALLA OBSERVATORY IN HUNGARY—WHAT IS A "FIELD GLASS?"—SEEING THE STARS IN THE TRAPEZIUM OF ORION—UPSETTING ONE'S GRAVITY—VERTICAL SUN ON DECEMBER 21ST—COMPLEMENTARY COLOURS IN THE POLARISCOPE—THE RECENT SUNSETS—THE USE OF A LIGHTNING CONDUCTOR—SATURN—CHINESE WHITE AND GLYCERINE—LIGHTNESS OF WINTER NIGHTS—RAIN GAUGE—FINDING THE MAGNIFYING POWER OF A TELESCOPE.

[22140.]—I would commend the study of the fifth annual volume of observations made at the Astro-Physical Observatory of Dr. Von Konkoly at O'Gyalla in Hungary, to the study and attention of all those who may feel disposed to listen to the whining of a party of pseudo-scientific mendicants in this country. These gentry (with one word for science and half-a-dozen for themselves) are never weary of assuring the ignorant British public that the one way only in which the physical structure of the heavenly bodies can be adequately and successfully studied in this country is by the establishment of a gorgeous and Palatial Physical Observatory—with a Directorate and Observerships on a corresponding scale—at the national expense, for the private pecuniary benefit (only on this point they are reticent) of certain hangers-on and creatures of the "Department" at Brompton. To anyone who may have been imposed upon by this kind of scientific begging-letter writing, I would, as I began by saying, commend the perusal of Dr. Von Konkoly's record of the mass of admirable work effected at O'Gyalla at his sole cost and charge. During the year 1882 the spectrum of Comet Wells was observed, as was that of the glorious Comet of September in that year, five bright lines in the hydrocarbon spectrum of which were measured. Observations, too, of the spectra of shooting stars were made. Numerous spectra of the fixed stars, also, were observed. Incredible as it may appear, daily observations of an exhaustive character of the Sun's surface, the structure and position of spots, &c., were made, whenever the sky was clear, in this observatory, unsubsidised by one single gulden by the Hungarian Diet. The spots have been specially observed in position with a view to the determination of the period of the Sun's rotation. Meteoric astronomy, also, would seem to have claimed a considerable share of attention; and of course, such phenomena as the partial Solar Eclipse of May 16, 1882, were not neglected. The whole volume affords evidence of the excellence of the work which is being carried on by the noble-minded Hungarian who produces it. Such disinterested labours as those of Dr. Von Konkoly go far to redeem science from the odium brought upon it by the mean and designing hangers-on to its skirts, whose sole idea seems to be to trade on it in the veriest huckstering spirit, and to pose as its votaries solely for the sake of what they can make out of it.

I am a little curious to know what sort of "field glass" it can be of which "Orion" speaks in letter 22098 (p. 301) as "magnifying about 25 diameters." "Field glass" is a word which has acquired a definite technical meaning, and is, in this country, understood to mean a double Galilean telescope, magnifying from 4 to 6 diameters at the outside. I really ask for information.

The dictum of Dr. Klein, concerning the visibility of the two fainter stars in the Trapezium of θ Orionis (quoted by Mr. Dunlop in letter 22102, p. 304) suggests a reminiscence of the Irish pickpocket, who, on being told that two witnesses distinctly saw him take a gentleman's handkerchief, replied that he "would bring six witnesses who didn't see him take it!"

I have often said that I must decline to do sums for anybody; but glancing over query 52392 (p. 313), I would venture to point out to "Beginner" that if he takes 257·6 from 480, he will find that 222·4, and *not* 122·4, remain.

In reply to query 52398 (p. 313), the Sun will be vertical at Greenwich Mean Moon on the 21st (the day when this will appear) over a point in the South Atlantic Ocean to the west of the Great Namaqualand in South Africa. At midnight on the same day, he will be exactly overhead in a part of the South Pacific to the southwest of the Friendly Islands, and not very far from the "Minerva Reef" of the charts. In the first case, the latitude of the point will, of course, be 23° 27′ South, and its longitude 1min. 48sec. West. In the latter, the latitude remaining sensibly the same, the longitude will be 11h. 58m. 27s. East.

It would take up too much space in a mere letter to answer query 52442 (p. 314) adequately; but "Nicol" will find the explanation he seeks in "The Polarisation of Light," by the late lamented President of the Royal Society, in the "Nature" Series, published by MacMillan and Co.

The perfectly glorious sunsets—or, to speak more accurately, exhibitions of the afterglow—to which reference is made by Mr. Ingall in query 52435 (p. 314) are now known to have been observed in Europe, Asia, Africa, and America. Hence, it would seem that we must look for some cosmical cause for these exquisite phenomena. An attempt has been made to trace their origin to the terrible volcanic eruption in Java in August last, it being alleged that the pulverulent ejecta of the Javan volcano Krakatoa have been carried up into the air, and diffused by currents through the entire atmosphere. Apart from a consideration immediately to be referred to, I think that anyone who will study Maury's "Physical Geography of the Sea," or any good text-book on physical geography, will see that the perfectly well-ascertained course of the chief atmospheric currents will suffice to dispose of this hypothesis. The consideration to which I have just referred, moreover, seems further to put its unsoundness and unscientific character beyond a doubt. It is this: A good deal of snow fell in this country during the first week in December; and, naturally, in its descent it would bring down any minute particles which happened to be floating in the air. If these particles were limited in number (as they must be if they consist of the dust from a single volcano), the snow would, as I have said, bring them down, and there would be an end of the phenomena to which they gave rise. Now, as it happens, after the chief fall of snow, it was a matter of common observation that, for a night or two, nothing whatever remarkable was visible after sunset. Since then, though, the western sky has on more than one occasion glowed with tints of the same unearthly beauty as those which had previously set all mankind, civilised and savage, wondering. The second explanation which has been advanced seems to me to meet this difficulty. It is that the earth has encountered a ring or cloud of meteoric matter in space, and that it is to impalpable particles of iron in the upper regions of our atmosphere, that we must look for an explanation of the recent enchantingly beautiful phenomena. For, while as in the former case snow would bring down this meteoric powder, and temporarily clear the atmosphere, as the earth continued her course through the external ring of it, fresh particles would descend towards her surface, and be carried over it by the currents existing in the air. It would be important to ascertain whether anyone collected the snow which fell early this month and examined the sediment deposited when it melted, chemically and microscopically. If so, and such sediment was found to consist mainly, or largely, of iron oxide, it seems to me that the meteoric theory would be placed almost beyond dispute. (Since writing these lines, I see, from one of your contemporaries, that two observers, at least, found the sediment from the snow which fell on the 6th and 7th, to be full of iron dust.)

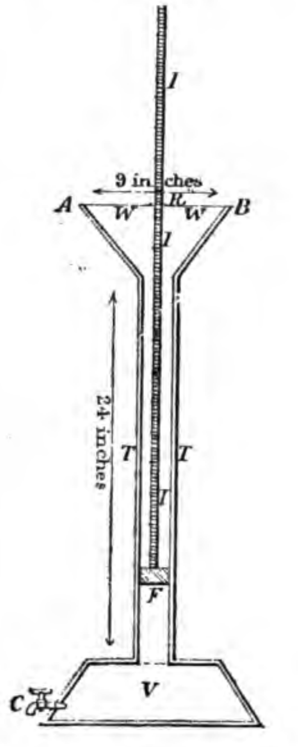
People, speaking generally, place such blind and implicit faith in lightning-conductors erected by competent manufacturers and under proper supervision, that I rather wonder that so little notice has been taken of the extraordinary accident which happened at Chichester Cathedral during the thunderstorm on November 25th. The spire was fitted with a lightning-conductor formed of a kind of woven copper ribbon, which was connected with the spire by iron staples and passed through glass insulators, ultimately descending 6ft. into the ground. Now, the lightning struck this elaborate arrangement, fusing and utterly destroying some 150ft of it (commencing about 40ft. from the top of the spire), and scattering thousands and thousands of fragments to a distance equal to the length of the part destroyed. At the parapet the lightning seems to have quitted the conductor altogether, travelled along the lead gutter, and so down a stack-pipe which it split all to pieces. This seems to me to open a very serious question indeed; because if so elaborate an affair as the Chichester conductor proved so much worse than useless when a thunderstorm came, what security have we that a similar disaster may not befall at, say, the Government magazines at Purfleet or elsewhere? I should like to know what "Sigma" has to say about this. Possessing the profound and intimate acquaintance with electrical science that he does, any utterance of his on a question of such real importance to the public safety could not fail to be valuable.

I do not quite know whether the editorial footnote on p. 321 is meant to convey a gentle hint to myself, or not; but I may begin my replies to those of my brother correspondents who have commented on the reproduction of my sketch of Saturn on p. 263, by saying that my own copy of the English Mechanic contains such a wretchedly bad impression of the wood-cut that it is hard to tell exactly to what extent the engraver is in fault. I can, however, state quite definitely that he has not exactly copied what I drew. Notably is this the case with the shadow of the planet on the rings; the equatorial edge of the dark polar capping (which was parallel to the elliptical curve of the inner edge of the ring, and not cocking up on the following side, as in the picture); in the breadth of Cassini's division, and so on. Moreover, my Saturn was on a black background, which your artist has eliminated altogether. With reference to what Mr. Baird Gemmill says, in letter 22121 (p. 321), about the markings on the ball, though, I may remark that *during the time that I was making my sketch* the polar shading on the planet was practically homogeneous, although I have often seen the ball striped by parallel belts. The darkening of the preceding portion of the edge of the polar capping was evolved from the depths of the moral conciousness of the engraver, as I saw nothing of the kind. I can, however, say definitely, that no "wavy" appearance of the edge of this shading was perceptible while I was drawing the planet. Before concluding my remarks in connection with letter 22121, I should like to express my entire concurrence with Mr. Gemmill as to the importance of watching for the passage of Saturn over stars of any considerable size. I quite agree with Prebendary Webb that very important information as to the constitution of the rings might be obtained from the observation of such a phenomenon. Turning now to Mr. Vivian's letter (22125), on p. 323, I would say that he is quite right about Cassini's division being broader in the ansæ than your engraver has represented—and as I drew—it. The dusky ring was very fairly well seen on the night of the 9th ult., but I could not, as I stated in my letter (22053, p. 263), see its inner edge as absolutely continuous all round. It was sharp enough in the ansæ, and, of course, where it crossed the body of the planet; but I could not quite connect the whole of its visible inner edge as part of a continuous ellipse. The small portion which was seemingly discontinuous, was obviously that nearest the earth. How this was engraved I don't know. In my own copy the interval between the ball and the rings is a hopeless smudge! As an illustration of the variation of Saturnian detail under slight atmospheric changes, &c., I may mention that although while I was sketching the planet on the 9th of November, not a trace of Encke's division in ring A was perceptible, I could hold it quite steadily, for many seconds at a time, on that of the 5th inst. I have not specially noticed that Saturn and Jupiter require different foci, as stated by "Brickwall" (letter 22126, p. 323). Assuming that they do, I think it probable that the greatly superior brilliancy of Jupiter must contract the pupil of the eye, and so produce a slight change in its focal adjustment.

In connection with the concluding paragraph of letter 22126, I should like, as the unfortunate "Someone," who has incurred "Brickwall's" wrath by recommending (p. 36) the addition of glycerine to Chinese white to soften it, to recall to his recollection the anecdote of the old woman who pestered her minister to pray for rain. For some time he, sensibly enough, refused; but, overcome by her importunities, at last yielded to her request. Immediately there came a violent hailstorm and cut up all her cabbages. "Ah!" exclaimed the old lady, "that's just like Mr. Jones—*he always overdoes everything!*" "Brickwall" has been "overdoing" the glycerine—that's all. I should never have dreamed of recommending it, had I not previously employed it myself with perfect success.

I think that it was Arago who suggested that the strange lightness of some moonless nights to which "M. A." calls attention in letter 22127 (p. 323), possibly has its origin in the phosphorescence of the earth itself.

How will this suit "M.M.I.Sc.S." (query 52489, p. 331)? Here A B represents the mouth of a funnel, which should be accurately turned in the lathe to an internal diameter of 9in.; T T is a tube of precisely 2in. in internal diameter and 24in. high, into which the funnel fits; the other end of this tube entering the vessel V, which is furnished with a tap C; F is a wooden float fitting the interior of the tube T, but not so tightly as to prevent its easy motion up and down. From the centre of this float rises the rod I, I, I, which is kept vertical by passing through the thin ring R, supported over the centre of the funnel's mouth by the wires W, W. It only remains to graduate the wooden index rod I, I, and our rain gauge is complete. This may be done by considering that as area × depth = volume, a cylindrical inch of water 9in. in diameter, will fill 20·25 inches of a cylinder only 2in. in diameter, so that all we have to do is to measure off 20¼in. from the bottom of the float F upwards, and divide this into 100 parts (each of them obviously 0·2025in. in length) to get what we require. The ring R forms our index. We commence by filling the vessel V to the level of the bottom of the 2in. tube, and then mark 0 on that part of the rod I, I, cut by the ring R: ·2025in. lower down the mark 1, and so on. Then it is abundantly evident that as the rain enters the funnel and passes down into the tube, for every hundredth of an inch that falls on the 9in. area the float will rise 0·2025in., and the divisions being perfectly legible may be read out of window by the aid of a field-glass or opera-glass. When the index is up to the top, the water must be drawn off by the tap C until it sinks to zero again.



Brewster's method of obtaining the magnifying power of a telescope, to which "A. A." refers in query 52496 (p. 331), is accurate enough in theory, albeit not a very practical one. The results would not be correct if the paper circle were too near, because the focus of the telescope would have to be altered; and it is the magnifying power of a telescope, when adjusted for parallel rays, that is always measured.

A Fellow of the Royal Astronomical Society.

SELENOGRAPHICAL—FRACASTORIUS—ALFONSUS—HORROX.

[22141.]—In connection with my last letter on this formation (22099), allow me to add an observation made on Sept. 2, 1882, 5h. to 6h. a.m., and which was overlooked at the time I wrote last. I transcribe from my observing book:—

"On April 21, 1874, 8h. to 9h. p.m., I discovered the rills *a* and *b* on the floor of Fracastorius. I noticed then that rill *b* was not so easy as rill *a*, but that it was well seen from crater *c* to its junction with *a*. This morning, on the contrary, rill *a* was not seen at all, nor rill *b* for some distance from *a*; but the portion from *b* to 5 was very well seen. This observation, therefore, completes fully that of April 21, 1874, and dispels all doubt about the existence of rill *b* from *c* to mountain 5 on the W.

Alfonsus.—Every selenographer has noticed the three or four dark spots contained in Alfonsus. On May 15, 1883, 8h. p.m., I found a whitish craterlet in the centre of the triangular spot on the E. of the floor, and a darkish one in the centre of the round spot on the S.W. Schmidt, who has closely watched these spots and detected variations, does not mention any of these craters. I shall be glad to hear what other selenographers have seen here.

Horrox.—Dec. 6, 1883, 8h. 30m. p.m., found three very minute craterlets on the N.W. outside slope of Horrox, the middle one and the largest of which is faintly shown in Schmidt's map. At this time the floor of Horrox was nearly full of shadow.

C. Gaudibert.

SATURN.

[22142.]—Mr. Gemmill (letter 22121, p. 321) has done good service in calling attention to the utter absence of systematic observation of this planet. There are plenty of observers and instruments; what we need is hearty co-operation. The Liverpool Society are, I believe, moving in this and other matters: perhaps a few suggestions as to this planet may now be useful. The following points, I conceive, are worthy of attention:—

1.—The Ball.
  a. Number of belts seen at any one time.
  b. Oblique belts, or any deviation from the usual parallelism.
  c. Waviness of outline, especially the boundary between the bright equatorial region and the first dark belt.
  d. Colour of the belts and different parts of ball.
  e. Bright or dark spots on ball.
2.—Ring A (outermost).
  a. Dark lines or bright streaks.
  b. Comparative brightness of inner and outer edge.
3. Ring B (middle).
  a. Streakiness or shading.
  b. Inner edge is suspected of variability in brightness.
4.—Ring C (inner or dusky).
  a. Mottling or streakiness.
  b. Colour.
  c. Comparative breadth where it crosses the ball, and in the ansæ.
  d. Relative brightness in each ansa.
  e. Least aperture with which distinctly seen.
  f. In which ansa there appears the greater extent of dark sky.

Should a star be seen within the ansæ, its behaviour when passing behind the dusky ring, and in Cassini's division, should be carefully noted. The exact time of any observation should be recorded, and it is desirable to make sketches (however rough) illustrating the particular feature under observation. Aperture of telescope (reflector or refractor) and power of eyepiece should always be given.

W. S. Franks.

SATURN'S RINGS—DEFINITION OF JUPITER AND SATURN—LIGHT NIGHTS.

[22143.]—If Mr. S. Maitland Baird Gemmill will *dele* the letters "er" after "great," in the sentence respecting Saturn, to which he refers in letter 22121, p. 321, he will perhaps arrive at the meaning intended. The sentence will then read: "No doubt the rings of this planet monopolise observers to such a degree that they neglect other phenomena which, though less attractive, may be of great significance and interest." The error probably arose in copying, and escaped me in proof.

None of us will dissent from the views of this correspondent when he says that "no astronomical phenomena *can* be *in themselves* of *greater* significance and interest than the rings of Saturn"; but it is rather staggering to find him, immediately afterwards, advocating the publication of drawings in which the rings are to be omitted altogether!

The fact that Saturn appears better defined in a telescope than Jupiter has lately been mentioned in your columns. I have almost invariably had the same experience. In the Autumn of 1880 the fact struck me as especially well marked, and I wrote to the *Popular Science Review* for Jan., 1881 (see p. 12), mentioning the circumstance.

The occasional lightness of winter nights referred to by "M.A." (22127, p. 323) has been noticed here at different times. No doubt the peculiarity is due to a diffused form of aurora or some allied phenomena. On March 2, 1883, I recorded that "The latter part of the night was very light, though the evening was extremely dark. The sky appeared to be suffused with a glow as of faint moonlight." My notebook contains mention of other instances of similar character, though I never made an effort to observe and record the phenomenon systematically.

Bristol, Dec. 15. **W. F. Denning.**

THE WESTINGHOUSE BRAKE.

[22144.]—In the English Mechanic of Nov. 23, "Imprimatur," in drawing attention to failures of the Westinghouse brake, asserts that you are constantly receiving evidence of the unsatisfactory condition of the brake in the United States. He also mentions a disastrous accident on the Long Island Railroad as one of the shortcomings of the brake in question. As a matter of justice, I wish to say that the brake that failed on the Long Island Railroad was the Smith vacuum. I ran a locomotive for five years on an American railroad, and used the Westinghouse brake the most of the [illegible] locomotive. I was in charge [illegible] for upwards of two years, [illegible] no difficulty in keeping the [illegible] when the [illegible] them [illegible] as well as incompetent. [illegible] important road in America, with [illegible] what [illegible] the Westinghouse [illegible] passenger equipment, and the brake [illegible] available as the locomotive. Most [illegible] are operated without any station [illegible] and the brakes relied on entirely [illegible] and the effectual manner [illegible] duty is the best testimony as to its [illegible]

[illegible] prevalence of failures reported by your [illegible] against the Westinghouse brake, [illegible] indicate that it is not taken very [illegible]

New York, U.S.A., Dec. 3. **Angus.**

[illegible]NCERNING LOCOMOTIVE ENGINES.

[illegible] Mr. W. J. [illegible] (p. 30[illegible]) appears to [illegible] reply, p. [illegible] I pointed out, [illegible] of an express engine [illegible] miles an hour should move at [illegible] Different locomotive super- [illegible] different opinions as to the best [illegible] speed to adopt, in proof of which I refer [illegible] the various speeds of pistons [illegible] Locomotive boilers generally [illegible] per square inch, to give the [illegible] is impossible. The "load," [illegible] of wind, &c., must all be [illegible] and even two drivers will [illegible] in the same way. The rule [illegible] has often been given in your [illegible] is perfectly correct. I have proved [illegible] in practical working. There is not, [illegible] calculation," to tell what speed [illegible] we should not see [illegible] so many engines [illegible] the expectations of [illegible] locomotives is the result [illegible] step by step. [illegible] cylinders and [illegible] strong enough, the designer, [illegible] cylinders to 18in. [illegible] the size of his [illegible] steam enough. [illegible] These are [illegible] locomotive [illegible] classed as [illegible] by experi- [illegible]

M. [illegible]

[illegible] ENGINES

[illegible]

somewhat as a [illegible] the fact that the com- pound engine has no theoretical superiority over the simple engine with the same expansion. Surely this fact is too obvious to require stating. The greater economy in practice (as expressed in an indicator diagram), is owing to a cause which "Engineer" leaves entirely unnoticed when he proceeds to answer the question—What are the advantages of the compound principle?

The main advantage is that the steam, at boiler pressure and temperature, enters a cylinder which has not just been cooled down to condenser temperature, but only to comparatively high temperature, at which it passes away to the second cylinder. Less steam is wasted at each admission *in re-heating the cylinder*, and this is the central fact of the compound engine. "Engineer" is right about the lessened strains upon the crank-pin, but he omits to notice another practical advantage of the compound engine. Instead of having a *large* slide-valve working under full boiler pressure, the compound engine has a small one, its large valve works under a much lower pressure. The gain in friction saved is a much larger percentage of the total indicated power than many engineers are aware of. Of course in this respect the disadvantage of the simple engine can be mitigated by balanced slide-valves, but the remedy is not without drawbacks, and it is better not to require it. Similarly, steam jacketing lessens the comparative waste of steam in re-heating the cylinder in a simple engine, but it does not abolish it entirely, and the saving is only the difference between the waste of steam in the cylinder and the lesser waste which is substituted for it in the steam jacket. Such numerical estimations as this of "Engineer's," without mathematics, are valuable to many readers, and it is to be hoped he will continue them, with due correction.

M. H. B.

LOND N AND MANCHESTER EXPRESS TRAINS.

[22147.]—Your correspondents "Lincoln," p. 282, and H. Bill, p. 290, have both furnished some interesting details relating to the speed of express trains between London and Manchester; but unfortunately, they both give the distance via the Midland Railway incorrectly.

On Monday, 2nd August, 1880, all the Midland Company's main line trains ran to and from the new Central Station, Manchester, instead of to London-road as formerly, thus increasing the distance by [illegible] miles 44 chains, and as the journey was performed in the same time, there was a considerable acceleration of speed. The Midland Company has three routes from London to Manchester Central, the distance being as follows:

	miles.	chains.
St. Pancras to Manchester Central, direct	190	39
St. Pancras, via Derby Station	191	9
St. Pancras via Derby and Trent Stations	191	69

[illegible] first, or shortest, route is not used by any of the ordinary passenger trains. The majority of the express trains run via Derby, 191 miles 9 chains, [illegible] the [illegible] newspaper express from St. Pancras and some others run via Derby and Trent stations. The positions of the various junctions will at once be understood by reference to Airey's Clearing House Railway Junction Diagrams. The question of railway speed between Manchester and London [illegible] special attention [illegible] competition is as very keen. A [illegible] passengers with a view [illegible] have decided that [illegible] by the fastest trains—that is, [illegible]

[illegible]

are carefully made, showing the number of passengers in each train by each route daily. It must, however, remembered the three lines are of different lengths, and run over various gradients; it is therefore possible that an amount of traffic which would pay one company might be a loss to another. There can be no doubt that the returns of such traffic when completed to the end of the year will form an important basis upon which to regulate the Manchester and London express trains.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Dec. 1[illegible].

CONTINUOUS BRAKES—PARKER-SMITH'S.

[22148.]—"Meteor" (letter 221[illegible], page [illegible]) is good enough to notice my remarks on Mr. Parker-Smith's continuous mechanical brake, but there are one or two things he says which should not pass without comment.

He says the vacuum on the G. W. R. brake is maintained by a pump worked from crosshead of engine. True, and that means some extra work for engine to do, and, of course, consumption of steam and fuel; but he says nothing about the use of the ejector necessary to release this brake before starting after every stop made with it, and he adds "thus the amount of stopping power stored up by the train is proportional to the velocity;" but he cannot mean this, for the velocity may be anything up to 60 or 70 miles an hour, and, as the stopping power is limited by atmospheric pressure, the two things, one strictly limited, the other not, cannot be proportional. "Meteor's" conclusion is unscientific, and does not follow from his premises.

To those who might accept the above assertion, "a constant brake power of, say, [illegible] per coach" may seem a big figure (it would need large drums or bellows and a good vacuum); but its efficiency is, of course, only relative.

Again, the illustration in the case of the Parker-Smith brake, which "Meteor" is illustrating against when he cites the G. W. R. vacuum brake, as to the power varying from nought (0) upwards with the speed of the train is not a happy one. The power at nought would not be a power (Hibernice!) and the train would be at rest, but let the train be on the move ever so slightly, the brake power depending upon its momentum would be at hand, more than sufficient, and would be proportional to its velocity *without limit*, except strength of materials previously alluded to.

"Meteor" is only generalising when he says the using the momentum to create brake power holds well theoretically, and may have arguments in favour of it; but when he comes to give us his practical illustration, instead of its being to the point, he gives us part of the modus operandi of an entirely different system—viz., the G. W. R. vacuum brake. Criticism, as well as "practical illustrations," should be to the point.

In passing, I may say that I look upon the Sanders and Bolitho G. W. R. vacuum brake, which "Meteor" is referring to, as about the best all round fluid brake, notwithstanding the objection that its power is so limited, but he should be just when advocating it to the disparagement of another system.

Traffic.

[2214[illegible].]—In my letter [illegible] I pointed out the importance of a "brake failure" depending on the class to which it belongs. I have now [illegible] up a list from the last return for the half-year ending June 30th, 1880, showing all cases of "failure or partial failure of the brake to [illegible] act under ordinary circumstances [illegible] when required." The returns [illegible] We have therefore [illegible] as follows:—

	No. [illegible]
Smith's vacuum, non-automatic	[illegible]
Clark and Webb's chain, non-automatic	[illegible]
Wilkin and Clark's chain, non-automatic	[illegible]
Barker's hydraulic, non-automatic	[illegible]
Westinghouse, automatic	[illegible]

Total. [illegible]

We have been told [illegible] the more simple a brake [illegible] that automatic brake [illegible] non-automatic." Now [illegible]

FAILURES.

	No. [illegible]
Non-automatic systems	[illegible]
Automatic systems	[illegible]

[illegible] non-automatic [illegible] brake. [illegible] the [illegible] automatic brake [illegible] when they [illegible] the figures [illegible]

the vehicles. These six cases are clearly
ie neglect of the couplers, and of the guards
isting the brakes as required by the railway
.es' regulations.
'orth British Co. reports "A pump did not
air pressure, as the air chamber of suction-
as filled with dirt, through want of atten-
. driver's mismanagement." The last case
Midland, where a rod broke on a tender,
brake was only out of order on this tender
train did not overrun the station. Now,
es the eight cases amount to? Simply
stances of "neglect of servants" and one
od, and even of these we find that in two
e was only affected upon one vehicle, and
trains did not overrun stations, so that in
fact the brakes did not "fail to stop a train
quired." I feel convinced the readers of
LISH MECHANIC will agree with me that
ts disprove the statements which have been
ainst automatic air-pressure brakes.

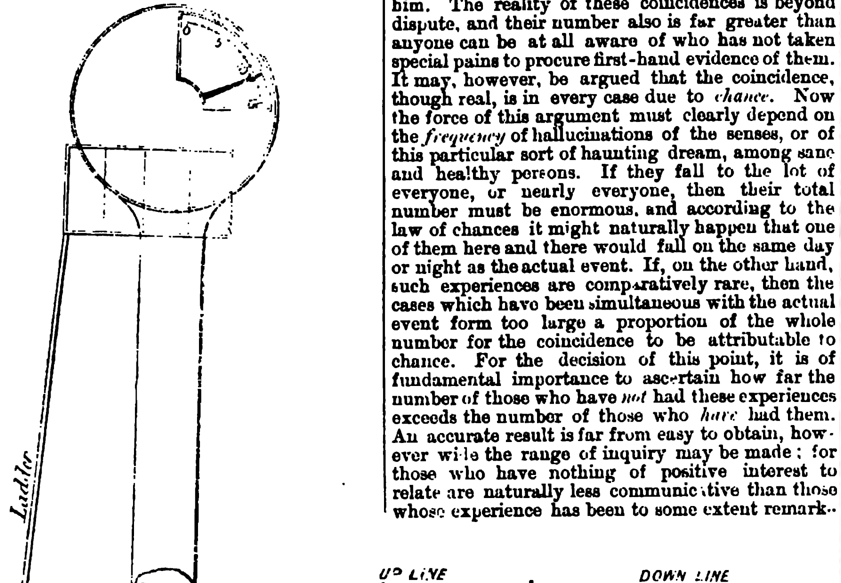
Clement E. Stretton.

Coburg-street, Leicester.

RAILWAY TIME SIGNALS.

.]—THE "Self-acting Time Indicators,"
your correspondent "Historian" (p. 314)
ere erected by the Midland Railway Com-
on the "up" side of the main line at
h and Kegworth stations during the early
he year 1863.

ndicator consisted of a circular column,
h (constructed of iron plates), supporting a
lock-face, of which, however, the diagram
ly one quarter, was visible to the engine
When a train passed the flange of the first
essed down a treadle (A), which by means
ranks (B) and rods (C) communicated
o the clockwork, and the hand on the dial
rom "0" and travelled to "15" minutes,
icating to a following engine-driver the
of minutes that had elapsed since the
f the previous train. Both sides of the
alike in appearance, but one applied to
he other to "down" trains. At night the
e illuminated by a lamp placed inside.
present when the two "indicators" were
ught into use, and as both were near to
I had many opportunities of watching
rking; they fulfilled the object for which
e erected; but it soon became apparent that
rval of time" did not insure safety, and
"interval of space" between all trains was
: the time indicators at Kibworth and
th have long since given place to the
block system.



Clement E. Stretton,

Coburg-street, Leicester, Dec. 12.

MICROSCOPIC TEST OBJECTS.

.]—THE letter of Mr. Edward M. Nelson
34) is one of the very highest interest, as
ses some hitherto entirely unknown and
ted facts in microscopy. After many
anxious consideration of the subject of
ion, latter-day microscopists had begun
atulate themselves that at last they had
the rationale of oblique illumination, and the conditions under which it was, not merely of service to, but a necessity for, microscopists.

This, however, is now all swept away at one blow, and, unless Mr. Nelson comes to our rescue, we shall be relegated to the old state of Cimmerian darkness, for he tells us he has discovered (1), That oblique illumination must be entirely abolished in favour of central; and (2), that by so doing we shall see the *true* structure of the objects.

I feel sure that he will not refuse to tell his brother microscopists how he has come to recognise these startling truths. It is not, of course, for me to dictate the form in which he should do this; but I feel that it will be very much more profitable (if he will forgive me for saying so) if he will go a little beyond the customary *sic credo stat pro ratione opinio*, and show us the various steps by which he was ultimately brought to realise the validity of his present view. We should all be able, I imagine, to follow him so much better, too, if he would not mind at the same time throwing in a little demonstration of where the fallacy is in the accepted notion that when central light has exhausted its powers of resolving given sets of lines, oblique light will show still more; and what must evidently be the still greater error of the current belief that with the objects of which he writes there can be no determination of structure as "true," and that oblique illumination must of necessity give us a nearer approximation to truth than central.

Thanking Mr. Nelson in advance for the interest which his communication will awaken.

Monachus.

SOCIETY FOR PSYCHICAL RESEARCH.

[22152.]—THE above-named Society has collected a very large number of cases where some marked event—usually either death or serious danger—happening to a person at a distance, has coincided either with the apparent perception, by some friend or relative, of that person's bodily presence, or with an exceptionally vivid and haunting dream of him. The reality of these coincidences is beyond dispute, and their number also is far greater than anyone can be at all aware of who has not taken special pains to procure first-hand evidence of them. It may, however, be argued that the coincidence, though real, is in every case due to *chance*. Now the force of this argument must clearly depend on the *frequency* of hallucinations of the senses, or of this particular sort of haunting dream, among sane and healthy persons. If they fall to the lot of everyone, or nearly everyone, then their total number must be enormous, and according to the law of chances it might naturally happen that one of them here and there would fall on the same day or night as the actual event. If, on the other hand, such experiences are comparatively rare, then the cases which have been simultaneous with the actual event form too large a proportion of the whole number for the coincidence to be attributable to chance. For the decision of this point, it is of fundamental importance to ascertain how far the number of those who have *not* had these experiences exceeds the number of those who *have* had them. An accurate result is far from easy to obtain, however wide the range of inquiry may be made; for those who have nothing of positive interest to relate are naturally less communicative than those whose experience has been to some extent remarkable. For our purpose it is, of course, essential to obtain a due proportion of *negative* answers, and with this object we have framed our inquiries in such a manner as to require no answer but "yes" or "no."

The questions to which we are desirous of obtaining a very large number of such monosyllabic replies are:—

(1) *Hallucinations.*—Have you ever, when in good health and completely awake, had a distinct impression of seeing or being touched by a human being, or of hearing a voice or sound which suggested a human presence, when no one was there?

(2) *Dreams.*—Can you recall that you have ever, in the course of the last ten years, when in good health, had a dream of the death of some person known to you (about whom you were not anxious at the time) which dream you marked as an exceptionally vivid one, and of which the distressing impression lasted for as long as an hour after you rose in the morning?

If any reader of this letter, in the course of the next six months, will repeat the above two questions *verbatim* to 20, 50, 100, or more trustworthy persons, *from whom he does not know which answer to expect*, and who have not already been interrogated by someone else, and if he will communicate the results, these will be most gratefully received and acknowledged, and he would render further aid by inducing others to do the same. In any case where a vivid impression or dream *has coincided* with the real event, it is particularly requested that the person who has had this experience will send me an independent account of it. In every other case where the answer is *affirmative*, a simple "yes" will be sufficient; but I should desire to have (not for publication) the *name and address* of any person who answers "yes," as well as of the collector. In the case of *negative* answers it will be sufficient if the collector will send (not for publication) his own name and address, with words "Hallucinations, 20 noes," "Dreams, 100 noes," or whatever it may be, on a postcard.

Edmund Gurney (Hon. Sec.)

14, Dean's-yard, Westminster, S.W.

HIDDEN LIGHT v. HALO.

[22153.]—A GASLIGHT has this misty circle round it; but on closing one eye and covering the flame with a finger held up between it and the open eye, the halo disappears, with a perfectly clear space apparently increasing the illumination. A fish-tail burner viewed edgewise is the easiest. It is very curious that the same light reflected in a mirror will not dispense with the halo, though treated in the same manner, neither will the moon when covered with a disc. How is this? Again, when the gaslight is covered with a straight folded piece of paper, so that the edge of flame and paper shall be coincident, the air motes are to be seen, very numerously attracted by the heated flame, yet never enter it, flying upwards with rapid velocity. I suppose these motes are the light reflectors popularised by Tyndall. I only mention them to show the contrast between their action and that of the hidden motes or particles shown in phosphene, letter 22081.

Fiddler.

"HOW TO MAKE A CHEAP LATHE."

[22154.]—WITHOUT being accused of finding fault with these excellent articles, may I be allowed to point out that the usual way in most toolshops of fastening the hand-wheel to spindle, Fig. 38 and 41, is not by a bit of $\frac{3}{16}$ wire driven through the boss, which would be considered a bungling job, but by boring the collar, Fig. 39, say $\frac{1}{2}$in., the spindle being left correspondingly large? The hand-wheel bored $\frac{1}{2}$in. is thus forced by the outside nut against a true shoulder, and if a good fit needs no pin or key.

I hope the writer will take this remark in the spirit in which it is intended, and if, at the conclusion of the Lathe Articles, he will give us "How to make a cheap Self-feeding Bench Drilling Machine," I feel sure he will earn the gratitude of others beside myself, who desire to see the "E. M." as in the days of old, when it was more mechanical and less of astronomy.

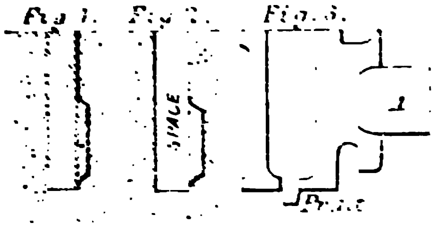
W. F.

LATHE MATTERS.

[22155.]—"WHEN a boss is cast on a stem or plate moulding vertically," it is only necessary to pin it on loosely with a wire, *provided*, however, that it is easily accessible, and that it be somewhat less in thickness than the space through which it is to be drawn. The annexed sketches will, I hope, make my meaning clear. Fig. 1 shows a plate and loose boss in the sand. When the sand is rammed round the boss, sufficiently to hold it in position, independently of the wire—the loop only of the wire being left exposed, the moulder draws the latter away, and completes the ramming up. That is the reason why I always use "wires" or "skewers" in preference to clasp nails, the former standing farther away than the latter, thus allowing of more complete envelopment of the boss in sand, and affording also a slight leverage to the finger in the act of withdrawal. When fully rammed up, the main pattern is lifted out and the mould has the appearance of Fig. 2. Then the moulder thrusts down a bit of bent pointed wire, generally his vent wire, or a nail, and sticking it into the boss, draws it out.

Now, another study of the sketches will show where loose pieces are inadmissible. Supposing the boss had been twice its present thickness, it could not have been drawn into the space left by the plate. In that case we should either cut the boss into two thicknesses divided longitudinally, and withdraw each thickness separately, or we should place a "drawback" against that face, that is a cast-iron plate upon which that portion of the mould is made, and drawn back, to be replaced when cleaned and finished, or we should core over the top of the boss. A case of this kind is illustrated in the "E. M." Vol. XXXVII. p. 427, Fig. 44. Or supposing the mould had been very deep, say three times what it appears to be in sketch, then a thin boss could not have been withdrawn because of the difficulty of reaching it. Then a drawback, a core, or a joint made in the mould across the centre of the boss, would get over the difficulty. The bosses on the back-gear arms of a headstock, being thin and the arms not very long, will in ordinary cases come into the mould easily, and so also will the V strips of lathe-bed castings when the bed is cored out. But when a lathe-bed pattern is made like the casting, either the middle sand, or the outer sand must be removed before they can be taken away.

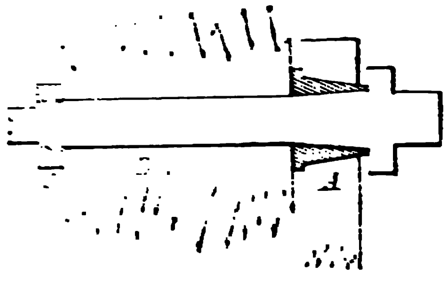
An article of mine in MS., in the Patt. Making series, is specially devoted to "Cores and Drawbacks," and will contain information on the moulding of patterns, the philosophy of pattern making, if I may use so high-sounding a term in connection with my little-known craft.



The bed you figure might be moulded with the V face downwards; but I should not make it so. I should mould it in the usual way, flanges downwards, coring out the inside, and taking out the recess in front with a core, the print for which, Fig. 3, A, should be wide, to balance the core well. There is not the slightest difficulty in making it thus. J. H.

LATHE MANDREL.

[illegible]—Lathe matters being to the front, I venture to send a sketch of a mandrel which I designed some time ago, but never had the opportunity to make. It is so simple that I hardly think it can be new, but I do not remember ever seeing anything like it in "ours." The objection to that class of mandrel running in one cone and a back centre, is that it is impossible to have a good shoulder for the chucks without having an abnormally large cone bearing. This mandrel does away with that objection, and has, I think, one or two other advantages. The sketch, which is not to any scale, explains itself. A conical bush or collar A is fixed [illegible] the shoulder of the mandrel, then the cone pulley B goes on, and the nut C screws up and makes all firm as one piece. The pulley would scarcely want a key, and if it did, it would not have to be fitted so tight as to require driving on and off, as has to be done where there is nothing to hold the pulley endways on the mandrel. Of course this would not apply to a back-gear lathe, as then the nut would have to go next the bush A. Another advantage is that it does away with the difficulty of hardening the mandrel, as the bush is much simpler to harden, [illegible] [illegible] [illegible] to make another. Also, the mandrel can be the whole length of headstock, as there would not have to be space enough to slip it back out of the front [illegible] [illegible], as in putting the mandrel in the bush would be put in its place, the cone pulley behind, and the mandrel slipped in from the front. The bush should fit on the mandrel slightly taper, and be [illegible] to its place after hardening. But this is only a detail of fitting. Will some of our lathe correspondents please criticise? Wessex.



AMATEUR WIND INSTRUMENT MAKING.—III.

[illegible]—In my previous paper I gave the sizes of wood to be employed for making the body of the instrument. Now as these sizes are only about one-eighth of an inch too long, it would be better to have them a little longer, as the [illegible] [illegible], and glass paper usually make the hole a little too wide at the end they are entered, so if an inch more is allowed it can be cut off afterwards. Those who wish to make the instrument in five pieces, viz., mouthpiece, socket, top and bottom joint and bell, the following will be about the sizes for C clarionet, allowing a quarter inch for dressing at each end:—Barrel, 2¼in. long; top joint, 8¼in. long (this includes two male joints); bottom joint, 9½in. long, includes the male joint for bell.

It must be noted that the barrel has two sockets, the upper for the mouthpiece, the under receives the upper joint. Figs. 5 and 6 show the complete instrument and the general arrangement of keys, &c.

It will be noticed that the body is not quite parallel, and although this is a matter of taste, yet if the diameter is much altered, the distance of holes from mouthpiece will require alteration. As increased thickness of wood in the body makes the air passage larger, consequently to maintain the pitch, the holes must be placed a little higher up. The diameters of body are for C clarionet as follows:—At mouthpiece, [illegible]; middle of barrel or double socket, [illegible]; tapering down to [illegible] at the middle of the instrument, and again increasing gradually to [illegible], where it joins the bell. However, the instrument looks quite as well when made parallel, say at [illegible].

The diameters of the B-flat clarionet are the same as for the C. The joints are cut in the body thus:—A rod of iron or brass about [illegible] long and [illegible] diameter is turned up parallel to fit the bore

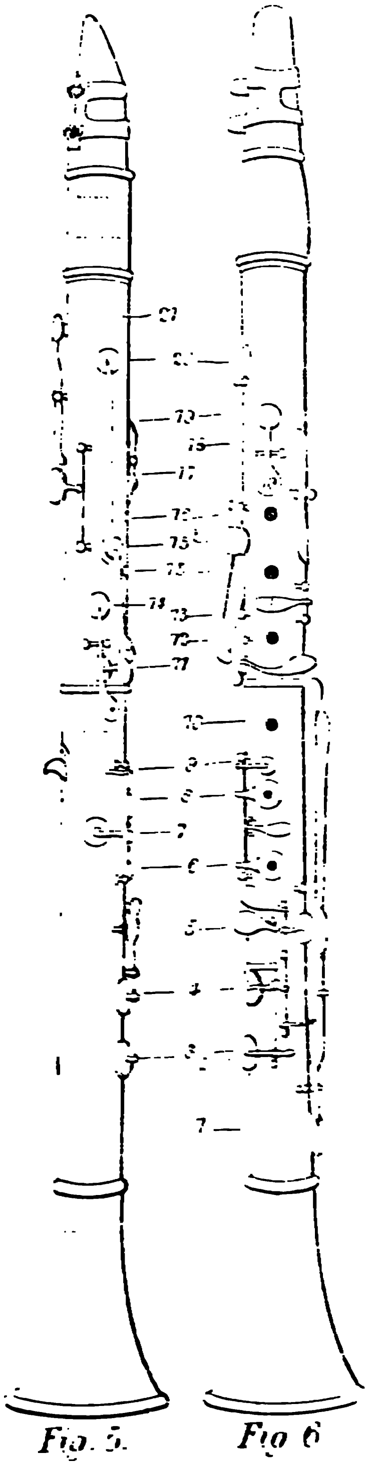


Fig. 5. Fig 6.

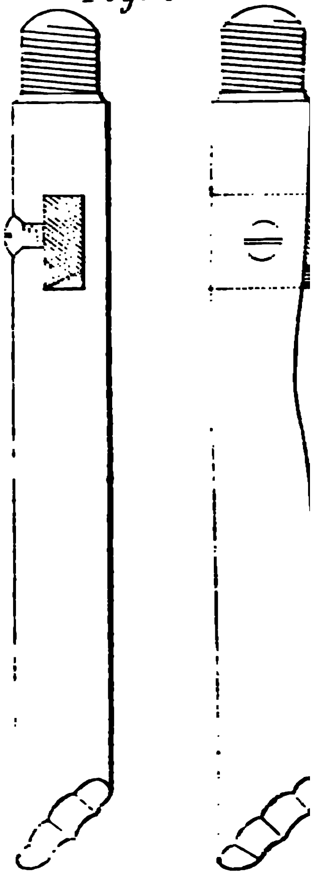
(14mill.) and polished: a slot is made
from one end and in this is fitted a s
secured by a screw (see Fig. 7); this all
adjusted to fit any size. The end is scr
lathe socket, and the joints are cut, the
held and screwed up by the back ce
spindle must fit the bore correctly, and
fair speed. The small recesses for me
the body are cut when the instrument is

Fig. 5 and 6 are drawn with the in
five parts to show the usual shape for
desire to make it so. The two top
sockets are all the same size to save trou
socket at bell end must be larger, the
26mill. diameter by 22mill. deep. The
are for C clarionet thus:—Mouthpie
socket, 4·2cent.; upper joint, 15·
joint, 20·3cent.; bell, 9·5cent.; total, 5

For B-flat the lengths are:—Mouthpie
socket, 5·5; upper joint, 17·7; lower
bell, 10·5; total, 63·6cent.

We now come to the division of the
correct positions of the sounding holes.
refer to the adjustable scale, figured in
of 28th September, 1883, and there ex
by me. The first step is to find what le

Fig. 7.



the correct bore' gives C concert pitch.
however, detail the difficulties of accu
mining these and following measurem
briefly state what I think is correct.

C Concert pitch = 134 vibrations p
produced by a plain tube 25in. long, m
the point of the reed, but when a tu
with holes, closed by keys, &c., the len
is [illegible]in., as the capacity of the tube
without alteration of its terminal diame
a slightly inverted cone and so sounds
octave above this, viz., C of 268 vibra
tube [illegible]in. A hole placed in the side
not sound as sharp as a tube of that l
other words, a plain tube of a certain l
"sharper than a side hole placed at t
tance in a longer tube," even though
pierced hole are the same diameter, fo
tube below a sounding hole has always
on pitch, usually making it flatter, and
is in proportion to the length of tube,
compared to those immediately below

The reasons why holes on a clarionet
the same size, like the Boehm flute,
small holes increase the facility of exec
performer's confidence, the tones as th
the reed become more wild and un
small holes tend to steady this defect
harmonics and upper register have to b
and a hole has sometimes to perform
parts, acting sometimes as a harmoni

sounding, and occasionally ventilating those above. Now a question arises of some importance: Some holes being badly ventilated owing to those below them being closed, as it is clear that some of the sound travels past them in a straight line, they will be more or less flat even if pierced at their correct places. There are two methods to remedy this: either to pierce them higher up, or to make them wider. If a hole would be very flat, its position must be raised, but if the tone is feeble or of poor quality it will generally be found best to widen it. The lowest hole on the clarionet when open sounds F, the position of this note will be found on the 24¾in. line as measuring 47·1cent. from reed, and as the thickness of wood is 7·mill. the hole would be placed at 46·4; but as it is impracticable to make this hole larger than 12·6mill., and allowing 2·6mill. for the flattening influences of the bell, and also the key hanging over, the correct distance is 46·0cent. Now the hole marked 19 on Figs. 5 and 6 is usually about 6mill. diameter and is placed at 16·3cent., the theoretical length, on the 23¾in. scale being 18·65cent., so it is about 23·5mill. too high, which is thus accounted for; 7·mill. for thickness of wood, 8·mill. for the difference in size, 2·mill. for pad, and 6·5mill. for the influence of tube below it, and bad ventilation owing to the half-tone below it being closed—viz., the G sharp. **Vulcanite.**

SLIDE VALVES—HOW TO SET THEM.

(*Continued from page* 601, *last Vol.*)

[22158.]—I AM sorry to have been so long sending this letter, as I promised to send it the following week. I must first inform our many readers that I have been out of work for a short time, and had to knock about the country, so I have been rather unsettled.

Well, to set valves with the trammel, you require a tool like Fig. 4. A is a valve template made of two pieces of steel 2½ long, ⅝ wide, and ⅛ thick; one is bent square, as shown in sketch, and then the two are riveted; this must be exactly ⅛ thick at B. The next tool is a one-legged trammel; they are best made of sheet steel like sketch, as they are handier to handle. This will have to be made to your own length, according to the class. We will now start to set them. They have to be marked off first. Put one spindle and valve in temporarily; you then get valve template (Fig. 4), and put the piece B in port C against face. Suppose it is in back port, push valve up against the template at D; if the spindles come the cover at front, mark them there; if not at back end. You then take the trammel, put a centre dot in cylinder, and with valve up against D, mark the distance with trammel in centre on the spindle (see Fig. 5). Take template out and put it in front port, pull valve up against template D as before, and mark it off with trammel. Put a small centre in each of the scrat marks on spindle. (Mind, I am speaking of inside cylinders with valves between.) Take that spindle out and mark that off the same. Be sure and take care of centres in cylinders and on spindles. When they are marked off, you can box all up, put cover on, and buffer plank on; then get wheels under, set one side at a time, put one back and one fore-gear rod up. You can now proceed the same as with calliper, only instead of having to put your hand down port, you can see how much the valves travel by the marks on spindle. I will now tell you how to work with these marks: say, for instance, the eccentric is full throw on front centre; you take your trammel and mark the distance from centre dot in cylinder on the spindle. You then get a small pair of compasses, or spring dividers are best, open them out, and get the distance from back port centre dot on spindle to the scrat mark on spindle which you have just made. You then get a piece of tin, same as I have told you, and make a half circle; then turn wheel till eccentric comes full throw on back centre, and proceed as before. I think I have made this pretty clear. Anyone with the least knowledge about the slide-valve can go on all right. If I have made any errors I hope someone will point them out, and I will rectify them. I would advise those who have a lot of valves to set, to get into this way. Of course use is second nature; but when you get used to it you can have the wheel turned one revolution, and you can see which rod wants altering. Now to try the lead: proceed the same as I told you in my last; get crank on back and front centres; when on the centres, if the trammel when in centre dot on cylinder comes into the dot on spindle, the engine has got ⅛ lead. You will be able to find whether it is more by a little looking at. Before I draw to a close, I should like some of our correspondents to tell us how to set eccentrics on crank shafts before putting them in. **Camomile.**

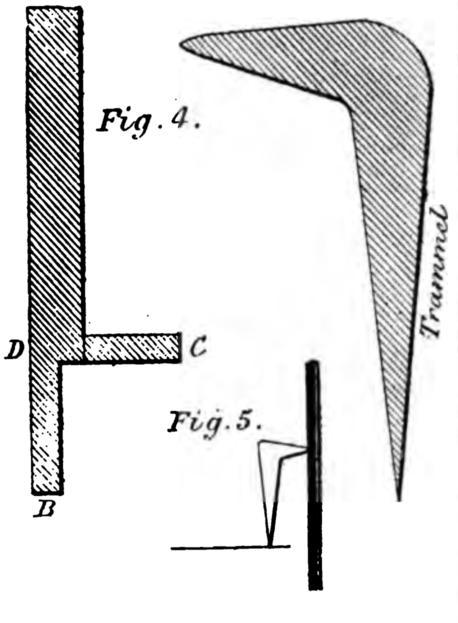
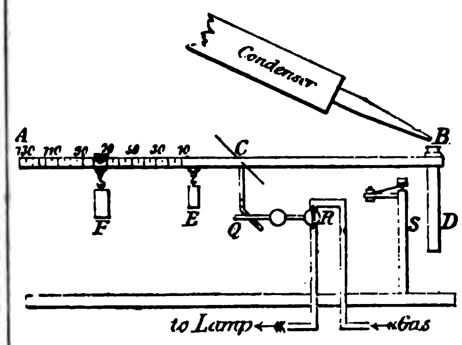


Fig. 4.
Fig. 5.

DISTILLING DEFINITE QUANTITIES OF LIQUIDS.

[22159.]—I INCLOSE you a sketch of a little contrivance which I devised some time ago for use in distilling off definite quantities of liquids, by which the lamp under the retort is automatically extinguished at the proper moment.



I do not know if the idea has any claim to originality; but it has proved so exceedingly useful in laboratory operations, that I think some of your readers might also find it of service.

A B is a beam turning on a pivot at C. The receiver D is counterpoised by means of the weight E. A sliding weight moves along the graduated portion of the beam. The beam is so graduated that 10cc. of water in the receiver just overbalances the counterpoise when the latter is placed at the figure 10 of the graduation. 20cc. in the receiver just overbalances the counterpoise when the latter is placed at the figure 20, and so on. The overbalancing of the beam releases the wire Q, which being loaded with a weight and attached to the stopcock R (supplying gas to the burner under the retort), shuts it off and stops the distillation.

The pillar S contains two wires in connection with an electric bell. When the distillate overbalances the counterpoise, the bottom of the beam presses on a feeble spring, which causes the completion of the electric circuit, so that the bell alarms simultaneously with the extinguishing of the lamp.

Anyone in the habit of conducting such operations as Wanklyn's ammonia process, in which successive portions of liquid have to be distilled off, will readily appreciate the nature of this automatic arrangement, obviating, as it does, the necessity for continual supervision.

Francis Heron.

LANTERN AND LIMELIGHT MATTERS —MICROSCOPICAL MOUNTING.

[22160.]—As I see recent letters on lantern and limelight matters are still referred to, I send a few practical remarks upon them, though I must refer to the substance of the queries from memory only.

The first query was as to the comparative optical conditions of wick'd lamps and the limelight. That is easily elucidated. If the light emanates from a *point* A in one conjugate focus of the condensers C, Fig. 1, the rays will converge (disregarding aberration) to the other conjugate focus B. It will be seen that the slide S can readily be placed in the converging cone of rays so as to take up all the light, and that a focussing lens F can also be made readily to take up all the light and transmit it to the screen. In practice the best limelight is not a point—would that it were so: my pending experiments with the microscope would then present far fewer difficulties—but it is sufficiently near it for these theoretical conditions not to depart grossly from the truth: and the consequence is, that even a *small* objective, say 1½in. diameter or less, will transmit all the light, and give a bright picture. Supposing that with any given objective part of the cone does, as the lantern may be set by chance, pass outside the lens, a little withdrawal of A from C brings the luminous cone down smaller, so as to pass through the lens.

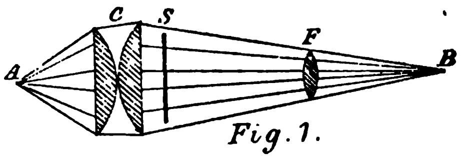


Fig. 1.

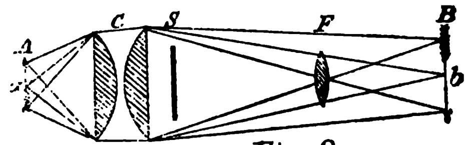


Fig. 2.

In practice this is done as follows, and I only mention what will make most lanternists smile, because it has been found that some lecturers really do *not* know about it, incredible as this may seem. Any slide is put in the stage, and focussed on the screen, without any trouble as to adjusting the light: we only want a bit of image, sharp, to be sure the objective is in its working position for that occasion. Then the slide is withdrawn, and the jet is carefully centred, and advanced or withdrawn, until the blank disc of light is centrally illuminated with an *even* and *maximum* brightness all over. The lantern is then "set" for that particular screen distance. With very long focus lenses the cone will "spread" a little, and for that very reason such lenses are better not less than 2in. diameter, though 1⅝in. will perform very well up to 10in. or 12in.

But Fig. 2 will show that with oil lamps the conditions are very much changed. The same letters refer to the same parts as before. The radiant or lamp A, now, is of considerable size relative to the diameter of the condensers, and the result is, that while any one central point *a* converges, as before, to the conjugate focus *b*, it is the same with every other point, and we get an *enlarged image* of the lamp-flame at B. Tracing the rays only from each extremity of A to the extremities of B, it will be seen how the effect of this is greatly to "spread" or scatter the cone of rays from the condensers. It begins to spread even at the position of the slide S, and by the time it has reached the objective F, no lens of reasonable size can include it all.

In practice these evils are met in three ways. 1. The best form of condenser for the limelight—the Herschel—is superseded by the double-plano form, which allows the slide to be brought *close* to the condensers, and so nearly avoids scattering of the light outside the slide itself. 2. The great breadth of the wicks practically *withdraws* a portion of the light A back from C, and so increases the convergence of the cone. 3, and chiefly. It is *necessary* to use larger objectives. Less than 2in. will not give nearly the best results with these lamps, and 2¼in. will give appreciably better. It will also be understood why these lanterns work best with condensers of a little longer focus.

A good 4-wick lamp like the Pamphengos will show a good bright picture on a 12ft. disc, with a 2in. lens; with a 1⅝in. lens the edge will be a little dim. On the other hand, none of these lamps can, from the nature of the case, give such sharp *definition* as the limelight. There are transmitted through the slide all sorts of crossing rays; and these must, and do, slightly blur the image; but on most slides this effect is not very observable, and chiefly comes out in hymns and sharp line diagrams.

A word further on condensers. I am surprised to see opticians go on repeating the old style by rule of thumb, making the lens next the light the same size as the other. Whichever make be adopted, this is wrong, as the light sent through the margin of the first lens passes outside the other. For a 4in. lens next the slide, 3½in. is sufficient next the light. This not only allows of thinner glass, but of somewhat *shorter radii* in the curves, either meniscus or plano, and even a little difference in this respect materially *lessens the aberrations*. I am quite certain that any optician who adopts this simple modification will find the result improved perceptibly, whether he employs the Herschel or plano form.

Now as to lime-jets. Several seem to wish both gases mixed in one bag, and speak of the "increased light." I do not believe there would be any increased light, to begin with: it is quite certain—and I make the statement most advisedly—that skilful modern operators get *more light* than was done in the old days. And if there were a little advantage, the danger would be ever present. The "safety" packing of lengths of wire described by one correspondent—Hemming's form—has repeatedly been known to explode. A more safe form was Gurney's, in which the gas was passed through *water* before being burnt; but explosion has taken place even in spite of that. I believe the safest packing would be Mr. W. Broughton's admirable granulated pumice-stone; but why run the risk? It is true that no explosion can take place *while pressure is kept up;* no packing at all is needed with that proviso. But weights may slide off at any time, and there is an appalling amount of risk from sheer mischief, as all who have shown to juvenile audiences well know. No; what we must look for is, some day to get compressed gases in bottles *cheap.* Whenever that comes to pass, as an experienced lanternist said to me the other day, our difficulties will be over; for we can then use a pair of *very small* bags with the *bottles for weights,* and thus keep all compact, and the pressure uniform. I do think we ought to be able to get oxygen at 3d. per foot. At that price there would be an amazing trade in large cities, and I fancy it would pay; as for 8ft. there would be 2s. received, while the chemicals cost 1s. 3d. only.

For several years I have been trying to persuade almost every optician I met with to bring out a jet, which should *raise the lime* the proper distance whilst revolving, so that the operator might just turn his lime steadily on through the whole evening. This was a want I had felt constantly, as others must have done. Last December Mr. Place, of Birmingham, told me he would, if he could find time, "have a try" for next (this) season, and I am glad to say he has lately sent me a jet which answers the requirement exactly, turning the lime in a continuous spiral, which rises $\frac{3}{8}$in. at each revolution, and gives 9in. of unbroken lime travel. It is also about the cheapest mixed jet in the market, costing only 18s. 6d. with cog gearing. The only drawback it has—with some lanterns only—is, that the lime-pin when down projects an inch below the jet; but I have been thankful to cut my lantern to allow of this. The only further improvement possible would be a screw adjustment, to approach or withdraw the lime while *on the screen,* so as to get the maximum of light, and this can be added for those who desire it. I have so long felt the want of a lime-movement of this kind, naming it in these columns long since, that I hope to be excused mentioning the matter now the want is supplied.

With any good jet, it is advisable to have an extra nozzle of different bore. More aperture is needed for a 20-ft. disc than for 14ft. Such extra nipples can be had for about 1s. 3d. each. And the operator will find it worth while to spend a little time and trouble over his own nozzles, seeing that they are perfectly smooth and true inside, and brought down to nearly a knife-edge outside; all clumsy nipples mean *shadow* on the condensers. One thing more: the brightest part of the lime extends from about $\frac{1}{32}$ *below* the nozzle to $\frac{1}{4}$in. above it. By *tipping forward* the whole jet and lime about 15 degrees, the nozzle is kept more out of the way, more of the brightest radiance bears on the condensers, and the light is increased nearly 10 per cent. For some purposes this expedient is well worth the ugliness it gives to the jet. A "tip" of more than 15° may increase the light a little more, but there is danger to the condensers.

Before laying down the pen, may I mention one or two matters *in re* "microscopic mounting." 1. To me, all *corked* bottles are very disagreeable and dirty for balsam work, and all who try them will soon prefer the wide-mouthed bottles, with ground external hollow caps, made for the express purpose, and which cost 1s. 3d. each. Failing these, the better gum-bottles with ground caps, or an ether-bottle or spirit lamp with the cap only, are nicer than corked bottles; but the wide-mouthed capped bottles are best. 2. In my opinion balsam in benzol is for almost every purpose far better than in chloroform. The unpleasant smell spoken of is unknown if really good benzol is procured, and preparers are not half particular enough about this. I have bought solution at a first-class shop (Beck's), which was useless, and smelt abominably; but what I use largely for mica work is quite free from objection on this score. I have found slides (purchased and others) prepared with chloroform particularly liable to disintegrate and show a multitude of spots, which I never knew with benzol. Moreover, chloroform evaporates almost too rapidly for any subject that needs time, while benzol is more moderate in this respect. 3. How is it that it is now almost impossible to procure insect preparations—such as the proboscis of a blow-fly—mounted in a really *first-class* manner? I have looked over many, and have one (given me by a friend) mounted *by the late* Mr. Topping, which is better than most, *and the best one I can get: but a* first-class one, such as I want, I can get *nowhere, at any price.* Go to a shop, and you can have your choice; but if they are showing you a lens, they will use one as a test, which you will find you *cannot buy.* At least, that is my experience, and I know one maker who is prepared to pay 5s. each for this particular preparation, prepared up to his standard, which is simply old Mr. Topping's *best* half of those he made. All that can be got now have far too much brown matter left in them; and in projecting a tongue with the lantern 6ft. long (a task I am now engaged upon, with, I am happy to say, very fair success so far), clearness and transparency are of great importance, the screen magnification representing 500 to 600 diameters. Still more important is it when showing parts of the organ on double that scale; it can easily be done with a good one, but scarcely at all with the trash usually sold now. To show I am not alone in this opinion, let me quote a few lines received this very morning from one of the first micro-photographers in the kingdom. He writes: "I shall be glad to hear how you get on with the fly's foot. Did you ever see a really good *transparent* mount of this object? I want one specially for photography, and have never succeeded in purchasing or borrowing one to my satisfaction." I am not sure if this correspondent really meant "foot" or "tongue," as I had only named the latter to him; but it comes to the same thing. Now and then I have seen one or another preparation by old Mr. Topping which were magnificent; but his art seems lost. Probably it is the multiplication of microscopes, and the demand for plenty as matter of trade. Still, it seems a pity that when a really good specimen, after the old style, is wanted, it cannot be got even by paying more for it. Would it not be worth while for some mounter to make—say at 2s. 6d. each—a few equal to what Mr. Topping used to sell to the trade for 8s. per dozen?

Dec. 14. **Lewis Wright.**

A SUGGESTION.

[22161.]—IT may, perhaps, be considered an error to place the cart before the horse, but I think the best place for the horse will be found inside the cart; and that he may use his strength in propelling instead of drawing the vehicle, is, I believe, the best way to utilise the power.

When we consider the great distance men are able to propel themselves on the tricycle, and the comparative ease with which their long journeys are performed, we may feel certain that the horse will be equally assisted by being placed in similar circumstances. A moving platform for him to drive backward as he pushes his neck into a fixed collar, may be connected with the wheels, and drive the whole like the tricycle.

Could not the wheels of bicycles, tricycles, and other carriages be made with tires of flat steel hoop, so as for them to bind on the ground, having all the weight suspended by the upper part of the wheel by the wires connecting the hub and tire, and making a spring to support the whole: and may not a very light and cheap vehicle be made by using one larger wheel between the shaft, like a wheelbarrow, when drawn instead of being propelled, and the shaft, being fixed to the saddle on the horse's back, would be held firmly, just as a man holds a wheelbarrow when drawing it, and the seat being placed on the level of the shaft, the centre of gravity will be so low as to cause little strain on the shaft at any time.

I believe a good-sized bicycle may be readily made into a gig of this sort by getting two pieces of $\frac{3}{8}$in. iron rod, each a foot long bent at a right angle, 6in. from one end, and then that bent piece again bent to go through the opening in the crank, where the pedal has been fixed, and screwed firmly into and against the crank, just as the pedal is fixed, so as to make a continuance of the axle 7in. outside the crank, and the space between the crank being 10in., the axle will be 2ft. long.

A frame of 2in. square deal 10ft. long and 20in. apart, having a crossbar mortised into it just as far from the end as to be before the wheel when the axle was 3in. from the ends, and having another cross-bar just so far before it as for the seat to be between them, and on a level with the axle, and the legs of the driver to be between them and the ground. The ends of the frame forming the shafts of the gig may then be fixed to the horse so firmly as to prevent either from rising or falling, and the rider will be safe from accidents if the horse is steady. **Philip Vallance.**

PARAFFIN AS AN INSULATOR.

[22162.]—A REMARK in the letter of Mr. B. Harcourt, on p. 325, that tissue paper cracked and broke after paraffining, suggests a suspicion that he has not been using paraffin, but some compound in which stearin formed the principal ingredient. Pure paraffin at any ordinary temperature has never cracked under my hands, though it might possibly become brittle at minus something or other of Fahrenheit's thermometer. Tissue paper, too, is not the right stuff; it should be what is called bank post, a very thin, but strong paper. The paraffin can be ironed in as "Os" says, but for some purposes it is better to soak the sheets in a bath of melted paraffin, and for others to dissolve the wax in benzoline—that will go almost anywhere, and evaporating leave the paraffin behind. At one time it was tolerably safe to buy a paraffin candle; but nowadays the wax itself must be asked for when paraffin is wanted. **Nun. Dor.**

TRICYCLES—APPARATUS IN AID OF HILL CLIMBING—A SUGGESTION.

[22163.]—IT would, of course, be a most desirable achievement if there were produced a sufficsently light apparatus which should form part of a trcycle, and be capable of its own force of either propelling the machine uphill or materially aiding the rider when making a steep ascent. Subject to the consideration of weight, there is no doubt whatever that such a desideratum could be accomplished by the proper adaptation to the tricycle's axle or otherwise of a powerful spring coil, which upon being wound up by suitable appliances, and being kept wound up in reserve for the occasion requiring its aid, should upon being released so act that its uncoiling would cause the driving wheels to revolve. Some time ago, a successful attempt was made to obtain a motive power of that description with the ultimate view to the propulsion of tramcars thereby. Large and powerful spring coils of a very tough material were made for the purpose, and they were to be wound up by stationary steam power at intervals along the route to be traversed by the tram-car. Successful preliminary trials of the spring coils were said to have been made in their application to some railway trucks; but as nothing more appears to have been heard of the matter it would seem probable the invention was not further prosecuted. The idea, however, in connection with tricycles seems sufficiently feasible if only some enterprising machinist would turn it to account. If it should add some 20lb. or 30lb. to the weight of a tricycle, the addition would be of little consequence, provided it relieved the driver when ascending steep gradients, for the propulsion of a tricycle along the level or up a slight incline needs but little labour. Supposing the apparatus could not be so applied that it should be wound up by the revolution of the machine's axle when going downhill; and even if it involved the necessity of its being wound up by the rider at the foot of every steep ascent, yet would the saving in muscle and backbone power on the rider's part be considerable. Irrespective of the level at which a tricyclist over ordinary roads in a country not mountainous begins and ends a journey, it may be taken that the total of his ascents upon that journey will, in vertical measurement, be exactly equal to the total of his descents; so that if he travels, say, 40 miles in a day, then 20 miles of the distance will be performed uphill and 20 down. As the downhill part of the journey needs but little exertion, it is plain that a very large proportion of the tricyclist's labour up those 20 miles of ascent would be saved if only some apparatus were devised that should afford material aid in propelling the machine uphill.

R. M. B.

TRICYCLES.

[22164.]—So much has been written on differing tricycles in "ours," especially on the subject of front and rear steering, that a little quite impartial criticism from experience may be useful. Up to last summer, I had generally ridden a rear-steering single driver, principally round London, and found it very satisfactory for speed, but very liable to sudden upsets, or narrow escapes if using the brake or back-pedalling suddenly. In either of these cases the momentum of the body will often cause the rear wheel to lift slightly, when away goes all steering power; and if there is any strain on the chain at the moment, either forward or backward, a sudden twist round and upset is the result. Even *relieving* the pressure on the back wheel, which *must* occur every time back pedalling is applied, is liable to cause unsteadiness. With such machines you must have a double brake, and when applying same suddenly, be careful not to back-pedal at the same time. In fact, they are not at all safe in case of a hurried (and flurried) stop being necessary. They are also very bad on slippery roads, especially up-hill, as they tend to twist round constantly. These defects made me resolve to adopt a double driver of some sort, and as the few trials I had had on the Cheylesmore had made me think I could never feel at home on a free pedal, I selected a front-steerer when three weeks' holiday gave me an opportunity of doing a little touring. I had one of the very best machines made, and expected to enjoy it hugely. I can only say I was disappointed. For shooting hills it was certainly splendid, but I found it bad at uphill work, and on the level could not get anything like my accustomed speed out of it; in fact, I could not keep up with my brother, riding the Cheylesmore I had despised. Of course, my machine was geared rather low—front-steerer [illegible] for 140 Miles.—To Mr. [illegible] a difficulty in working [illegible] but you may overcome [illegible] combined with others. As to [illegible] transmitter, you can use [illegible] spark coils, removing condenser and everything else really besides the bobbin [illegible] primary, and secondary wires. I would [illegible] to the platinum foil or sheet [illegible]. You can never entirely depend upon the latter.—W. J. LANCASTER.

[illegible]—**Diaphragms.**—To MR. LANCASTER.—When you have made the diaphragms, then well paper them with emery paper, and bronze them with a solution of nitrate of silver—say, 1drm. of silver and 2oz. of water; distilled water if you can get it—if not, clear rainwater. Hold the diaphragm with a wire hook, and heat it in a Bunsen flame or on a lacquering stove; then dip it into the bronzing liquid, take out when black, and cover it with powdered blacklead. This you can polish with a blacklead brush when nearly dry, and afterwards lacquer the diaphragms with a colourless lacquer.—W. J. LANCASTER.

[51907.]—**Turbine.**—To MR. LANCASTER.—I have no idea what such a turbine would cost, but I should not advise the use of a turbine unless you can get at least twice the power required by the dynamo when giving its full energy. If you will tell me what you want to do, I will tell you the best way to do it.—W. J. LANCASTER.

[51918.]—**Eyepiece.**—You may use the following lenses, beginning with eye lens and going to field lens of erector:—(*a*) Eye lens ¾in. diameter, 1½in. focus; (*b*) 1½in. diameter, 2½in. focus, 2in. apart; (*c*) ¾in. diameter, crossed convex, 2½in. focus, most convex surface towards eyepiece; (*d*) 1in. diameter, 2¼in. focus, plane side towards o.g. *a*, *b*, and *d* are all plano-convex; (*a*, *b*) should be 3in. from (*c*, *d*)—that is, really there should be 3in. between *b* and *c*. This distance may be lengthened to 5in. by mounting *a* and *b* in a tube which slides into tube containing *c* and *d*. You must have a diaphragm in eyepiece ⅝in. diameter, 1½in. from eye lens, and another diaphragm in erector ⅛in. diameter, 2¼in. from field lens of erector. Write again if you want further information.—W. J. LANCASTER.

[51953.]—**Electro - Motor.**—The amount of wire for the motor you mention would make a fair working instrument, but you would gain by using 18 wire for the armature instead of 16. Four of the cells you name would drive the motor well; six of them would give maximum power. It ought to drive a dentist's lathe easily, and of course would drive a sewing machine. The zincs of the bichromate batteries should be thicker at the bottom than the top, taper from bottom upwards.—W. J. LANCASTER.

[519[illegible].]—**Wasps' and Bees' Stings.**—I am not capable of giving to "F. G. A." any scientific disquisition upon "stings," but seeing that no one has replied to the query, I am able to assert that the irritation caused by the bite (or sting) of a flea (? sharp) is allayed by the application of a cold, damp cloth or sponge for a couple of minutes, just as the sting from a nettle is cooled off by the use of a few cold docken leaves. I hope this hint will be remembered by those who have the care of little children, to some of whom a flea-bite gives actual torture.—H. G. B.

[[illegible]]—**Oxy Hydrogen Microscope.**—To MR. LANCASTER.—I would advise you to do away with present form of jet and have a modern [illegible] jet with a platinum nozzle. Do not attempt to [illegible] gases in one bag or you will [illegible] the pages of "Ours." [illegible] and use two bags, [illegible] or say a little [illegible] the ratio of 2H. to 1 [illegible]. [illegible] I have no doubt [illegible] of a pair of [illegible] the pair [illegible] the light [illegible] W. J. LANCASTER.

[[illegible]]—To MR. LANCASTER.—[illegible]

[illegible] Medical Coil.—Build one [illegible] independent of

the primary. The latter should be built on a tube of either brown paper or thin ebonite; this should be fastened firmly to the two discs at each end. The brass tube should slide out smoothly.—W. J. LANCASTER.

[52043.]—**Limelight for the Lantern.**—You cannot do what you want without a train of wheels, and then there is the annoyance of the clogging of the wheels with lime dust. Better use the two bevel wheels with a nut outside for turning, and turn, say, one-fourth round every ten minutes. I have tried all kinds of motion for moving limes, but a pair of bevel wheels and the lime holder screwed is the best thing you can have.—W. J. LANCASTER.

[52103.]—**Engine.**—I have read the letter of "Engineer, Dewsbury," on p. 324, and can now reply to his question on p. 287. A greater theoretical power can always be obtained from a compound than from a single cylinder engine, all other things being equal. Steam engines are heat engines, and one is more economical than another in the proportion of heat-units passed through it without loss, as has been explained over and over again in this paper. I need not repeat, for on p. 329, reply 52393, by "Labor Omnia Vincit," he will find where he has lost himself.—ESSAR.

[52131.]—**Boiler Query.**—No doubt, as "Essar" says, "if you fill a boiler with water, as much as it will hold, and load the valve to four times what you would like to work at, and then light the fire, and if the valve lifts without the boiler showing signs of strain or leak, you may safely work at one-fourth the pressure indicated by the weight on the valve." But is it not possible that this would strain the boiler severely—in fact, make it weaker after the testing than it was before, and so tend to wear it out in a much shorter time than usual?—MACHINA.

[52165.]—**Slide-Rule Formulæ.**—On p. 269 of 974, Mr. F. A. Sheppard having made free use of your "Replies" columns of correspondents for decrying "all published works upon the slide rule" because of their being "overladen with gauge points" which he states have been the chief cause of the slide rule not getting into more general use, and the host of which gauge points he says "his improved double slide-rule for cubing quantities does away with, except in the most abstruse cases, which seldom occur." As I am the author of one of the maligned works, I take the liberty of challenging the soundness of Mr. Sheppard's conclusions, and of questioning the utility of his instruments and system of working. For the term "gauge point" meaning simply the multiplier or divisor number for converting money, weight, or measure, &c., of one denomination into another, 12 being the gauge point for shillings and pence or feet and inches, 112 for cwt. and lb., 144 for square feet and square inches, ·7854 for square and circular areas, 183·3 for square feet and circular inches, &c., inasmuch as the memory of any computor would have to be heavily taxed to keep in mind the gauge points relating to even the system of English weights and measures alone, so writers on arithmetic and on slide-rule calculations have generally provided such authentic tables of gauge points as they thought most likely to be useful for general calculations, and, taken for granted that computers would get off "by rote," such as were likely to be often wanted. And as for the example given by Mr. Sheppard, viz., to find the diameter of a pump for discharging 30 cubic feet of water per minute with effective lift of bucket equal 120 lineal feet in same time, his duodecimal rule is not adapted, and by his decimal rule and system of working he says: "As this question involves two operations we must prepare the rule by turning the upper slide so as to bring the line of square roots under the line of lengths," and then, 1st, place 30 on lower slide over 120 on lower fixed line to find 36 square inches area of pump over 144 on lower fixed line, and 2ndly, place 1 on lower slide over ·7854 on lower fixed line to find 45·57 for the inches squared of pump's diameter on lower slide over 36 on the lower fixed line; then, 3rdly, having placed the line of square roots exactly under the upper line of lengths, the diameter 6·75 inches of pump being on same square root line under the 45·57 on upper fixed line." As in conclusion Mr. Sheppard says, "Thus solving the question without the use of any gauge points, that is, by common arithmetic instead of by slide-rule arithmetic," it would be interesting to many of your readers to know, what but gaugepoints are the 144, ·7854 used by him in his calculation; and to compare his system of working with that usually applied to the solution of same question on even the single slide rule of Routledge by using the gauge point 183, when merely by

setting 120 on slide $\frac{B}{C}$ opposite 183 on A,

opposite 30 on do. $\frac{B}{C}$ is the ans. 6·76in. diam. of

pump on A, at a glance from a single setting. And, again, as according to Sheppard's circular, he says, respecting his "duodecimal rule," "If the question involves a greater cube quantity than 100ft., then one dimension must be halved, or otherwise divided, and the result similarly multiplied," whereas by the triple radius double slide-rule made by Stanley (which arrangement was in general use years before Sheppard), is adapted for cubing quantities to any extent, and for solving questions of simple and double rule-of-three, interest, involution, evolution, common and hyperbolic logarithms, trigonometry, and such questions as—

$$\sqrt{\frac{8{\cdot}5^3 \times 39 \times 66}{73 \times 97}} = 14{\cdot}95 \text{ very nearly.}$$

Or—

$$\sqrt[3]{\frac{9{\cdot}7^2 \times 59 \times 36}{91 \times 31}} = 4{\cdot}14 \text{ very nearly.}$$

at a single settling, and leave all the positions and results open for inspection at last; and a single rule suffices for all calculations made on the decimal system. I leave your readers to judge of the utility of the instruments thus brought to their notice, and the systems of working without and with tables of gauge points.—THOMAS DIXON.

[52166.]—**Engine Power.**—I think that if "Gossan" will look again at my answer to the above query, he will see that I am right. Let me remind "Gossan" that all calculations upon expansions must be reckoned from pure vacuum line, or 15lb. below atmosphere. In my calculation to the above query I took the engine to be a condensing one, with a back pressure of 3lb. in condenser. Then 50lb. boiler pressure and 15lb. atmosphere = 65lb., and 65lb. initial gross pressure upon piston, cut-off at half stroke; so if we divide the length of stroke by the point of cut-off, we shall get the number of expansions in the cylinder; or, 16 ÷ 8 = 2 expansions, and the hyperbolic log. of 2 expansions is ·693 + 1 = 1·693: then multiply 32·4 terminal by 1·693 = 55lb. But as the engine is a non-condensing one, instead of deducting 3lb. in condenser as back-pressure, deduct 15lb. for resistance of atmosphere, 55 − 15 = 40lb. effective average pressure throughout the stroke; the horse-power will be 143·139 × 192 × 40 ÷ 33000 = 33·3 horse-power. I think this will be sufficient to show how "Firer" got a greater average on piston than that stated in boiler.—FIRER, Dewsbury.

[52177.]—**Outer Walls of Houses.**—This querist should procure the Building Act, for the thicknesses vary with the length as well as the height of the walls. For length up to 30ft. and not more than 25ft. high, the party and external walls must be—footings 17in., remainder not less than 8½in.; if longer than 30ft., then footings 26in., 13in. below topmost story, and 8½in. for topmost story. For a house of three stories above basement, not more than 40ft. high and wall not longer than 35ft., footings 26in., below two topmost stories 13in., two topmost stories 8½in. If wall is longer than 35ft., then 35in. footings, 17½in. up to first story, intermediate 13in., and topmost story 8½in. If "Leo" requires further particulars I would refer him to the Act, or to B. Fletcher's "Textbook," published by Batsford, High Holborn.—S. R.

[52180.]—**Electro-Magnets.**—This query cannot be answered fully without making the experiment. You can excite a number of magnets in series, but it is doubtful whether they would all sustain the same weight. It would require very nice calculations to get the resistances, &c., so exact as to make the magnet at the negative or outgoing end the same strength as the positive, or end at which the current entered. I don't see how you could regulate the pull by current from an accumulator.—E. M. F.

[52181.]—**Balance Gear of Omnicycle.**—Seems strange that you cannot make out the gear with it before you. Is it not what is known as Starley's? which has been frequently described.—E. G. M.

[52199.]—**Ornamental Flower-pots.**—Has not "M. W. S." made some mistake? What sort of pots does he mean that they are moulded? The usual run of flowerpots (ornamental) are thrown on the wheel.—HANLEY.

[52201.]—**Discharging Water from Tanks.**—Is it impossible to arrange the tanks so that their levels could be altered as desired, and the water run from one to the other by gravity or by a siphon? If the levels cannot be alternately changed, best way would be to put one tank higher than the other, and then pump the water from the lower when wanted in the upper.—ESSAR.

[52259.]—**Acoustics.**—By the "pressure of steam" I presume is intended "pressure of hydrogen gas." There is also an important datum absent—viz., the density of mercury, which may be taken at 13·6. The fundamental formula for the velocity of sound in any medium is

$$v = \sqrt{\frac{e}{d}}$$

Where v is the velocity of sound, e the elasticity of the medium, and d the density, all measured in absolute units. The elasticity of the perfect gas, that is a gas perfectly obeying Boyle's law, is equal to the pressure if the gas is a perfect conductor of heat, or is equal to the pressure multiplied by 1·4, the ratio of the two specific heats, if heat cannot pass from one molecule to another in any way. In the case of the transmission of sound, the successive heating and cooling due to respective condensations and rarefactions take place so rapidly that the heat has no time to sensibly pass from one molecule to another, and we have the latter condition fulfilled. Therefore—

$$e = \text{height of barometer} \times \text{density of mercury} \times 981 \times 1{\cdot}41$$
$$= 73 \times 13{\cdot}6 \times 981 \times 1{\cdot}41$$

and—

$$d = {\cdot}000089 \times \tfrac{73}{76} \times \tfrac{273}{293}$$

the factor $\frac{73}{76}$ being that due to the law of Boyle and $\frac{273}{293}$ that due to the law of Charles. Dividing e by d, and observing that the number 73 cancels out, thereby indicating that the pressure makes no difference in the result, and taking the square root, we get—

$$v = 131304$$

which is 1313·04 metres or 4307·94ft. per second. The second part of this question can only be answered approximately. If t denotes the tension to which the string is subjected, and m its mass per unit of length, the number of vibrations executed in a second varies as the fraction $\sqrt{\frac{t}{m}}$. Let l and l' be the lengths of the string, best determined by experiment, when subjected to stretching forces F_1 and F_2 respectively. Then t is equal to F_1 in the first case and F_2 in the second. Also since $m\,l = m^1\,l^1$, we have $m^1 = \frac{m\,l}{l^1}$, and we obtain for the ratio of the number of vibrations in the first case to that in the second—

$$\sqrt{\frac{F_1 l}{F_2 l^1}}$$

If F_1 and F_2 do not differ much, we may assume the formula—

$$l_1 = l + cF_1$$

or the length of the string when subject to a tension is equal to its original length added to the product of a constant c and the tension F_1.—Nabla.

[52269.—**Acoustics.**—(1) The velocity of sound in any medium is given by the equation—

$$v = \sqrt{\frac{e}{d}}.$$

Where v is the velocity of sound, e the elasticity, and d the density of the medium In the case of a perfect gas, that is, a gas strictly obeying Boyle's law (and hydrogen does so sensibly) the elasticity is numerically equal to the pressure, as long as the temperature remains constant throughout the gas; but in the case of a gas subject to rapid alternations of compression and rarefaction, whereby heat is as rapidly evolved and absorbed at every point without having time to pass sensibly from one particle to another, the elasticity is represented by the product of the pressure and the number 1·41, the ratio of the two specific heats. In the case before us the pressure is equal to the product of the height of the mercury barometer, the specific gravity of mercury (13·6), and the acceleration due to gravity; hence,

$$e = 73 \times 13{\cdot}6 \times 981 \times 1{\cdot}41$$

and

$$d = {\cdot}000089 \times \frac{73}{76} \times \frac{273}{293}$$

the factor $\frac{73}{76}$ being the correction for pressure according to the law of Boyle, and $\frac{273}{293}$ that for temperature by the law of Charles. Dividing e by d, and taking the square root, preferably by logarithms, we get,

$$v = 131304 \text{ c.m.}$$

Or, $$v = 4307{\cdot}94 \text{ feet.}$$

It will be observed that before multiplying out the common factor 73 cancels. We might have expected this, since the velocity of sound in a gas does not depend upon the pressure. (2) The number of vibrations per second executed by a stretched string varies as the expression $\sqrt{\frac{t}{m}}$, where t is the tension, and m the mass per unit of length. Hence we must take into consideration the change in dimension of the string. If l be the original length and a be the increase in length produced by a force of one unit, then as long as F_1 and F_2 are not very great, the lengths of the string in the first and second cases will be $F_1 a + l$ and $F_2 a + l$, and the ratio of the mass of unit length in the first case to that in the second is $\frac{F_2 a + l}{F_1 a + l}$, and consequently we have for the ratio of the numbers of vibrations per second—

$$\sqrt{\frac{F_1\,(F_1 a + l)}{F_2\,(F_2 a + l)}}$$

It is thus seen that an increase in tension raises the number of vibrations in two ways; by increasing the tension and by diminishing the mass of the unit length.—Nabla.

[52271.]—**Lever Watch.**—I had formed two opinions myself as to the probable cause of the stopping of the lever watch, but have deferred sending a reply, in expectation that the important question of "Vulcan," would have received the consideration it deserved. In this I was rather disappointed. The single reply that appeared in the next issue was exception to by J. Sumner, who states that his experience of hundreds of cases is dead against its validity; at the same time, giving it as his opinion that the fault was to be found in the undue largeness of the balance holes. Having myself a great deal of experience in watch jobbing, I must say that I do not consider the reply of J. Sumner to be at all satisfactory, for it would be difficult to reconcile such an explanation with the fact that the watch is affected in different positions. It is the case, no doubt, that the guard-pin approaches unpleasantly near the roller, and for this reason I would consider that a steel guard-pin, not being so easily bent, would be more suitable than one of brass. The opinion I would offer myself, as the most reasonable one, is simply that the lever is "out of poise," so that in certain positions the balance is encumbered by having to overcome the excess of poise at every alternate vibration. When the lever is thus unevenly balanced on its pivots—as I have found it to be not unfrequently—the watch is still more liable to be stopped by any sudden shock or jerk it may receive, till perhaps some time afterwards another jerk may put it going again. With this defect the lever watch is liable to deceive, but when properly finished it excels all other kinds, even the chronometer, in being able to endure shaking and jolting without effect. In the present age of railway travelling, of course, such an advantage is of great account, and, therefore, it is that railway watches are fitted with the lever escapement. The next opinion I have to offer is, that perhaps the fault lies in the fusee getting bound in one of its holes when the watch is held in a certain position. My experience induces me to advise workers to make the fusee very free in its holes, if they are anxious that their watches should not stop, and not to be in favour of an exact fit, it being always attended with some degree of compression. The fusee should have perceptible end-shake and side-shake in its holes, because, on account of the great strain with which it is pulled round by the chain, it requires more freedom of movement than if it were turned like the other wheels of the train.—Watch Jobber.

[52281.]—**Boiling Silver Articles, &c.**—Better make them red hot with the blowpipe, and then boil them in sulphuric acid 1 part and water 8 parts, in a copper or stoneware vessel. Parts of jewellery, such as swivels, &c., containing a spring, should be first removed, or the spring will be spoilt. After boiling, scratch brush them.—J. E. A.

[52281.]—**Boiling Frosted and Chased Silver Articles to Whiten Them.**—You should boil solution of cyanide of potassium in an earthenware pipkin or enamelled iron saucepan, rinse silver in clean hot water, and dry in sawdust; keep the articles away from soapy water. Try this: Boil some water and dissolve some sal-enixon in it; then make the articles scalding hot and dip them in the hot solution of sal-enixon (crude sulphate of potash). I do not know the proportions, but I saw a jeweller cleaning frosted silver in this way, and he got splendid results.—Galvanoplast.

[52281.]—**Boiling Frosted and Chased Silver Articles to Whiten Them.**—To H. J. Sayer.—A tin saucepan, or inferior silver, may be the cause of failure. After cleaning the chain, boil well for five minutes in a jeweller's boiling-pan. There is another way. Heat the articles in the copper pan referred to, and drop into dilute sulphuric acid. I have used both processes successfully, but with sterling silver. I may add silver chains and necklets are made and sold at 2s. 6d. per ounce, and electro-plated to give them a finish. Seeing that unmanufactured sterling silver is worth about 5s. per ounce, I do not know whether so low a quality would "bleach" to look well. If "Young Jeweller" has any further difficulty, and will advertise his address, I shall be pleased to assist him.

[52284.]—**Telescopic Field of View.**—My thanks to "F.R.A.S." for his replies to my queries on page 273. To save space, I curtailed query 52284, p. 273, too much. I did not mean to ask method of finding diameter of field of an existing telescope, as I am well enough acquainted with that. (Arthur Mee, please notice.) I wanted merely to know (with regard to having a telescope made) what data would determine size of field? Delambre's formula, given by "F.R.A.S.," tells this.—E. M. R.

[52285.]—**Focal Adjustment of Astronomical Transits.**—Inasmuch as the astronomical transit has its system of wires fixed in the stellar focus, how is one supposed to adjust on a meridian mark 30 or 40 yards off? Distinct vision may be got by sliding eyepiece, but the wires won't be in focus. Query.—Would contracting the aperture of object-glass by a stop be of any use in getting rid of parallax of wires?—E. M. R.

[52297.]—**G.E.R. Engines.** — Another new goods engine (like 440) was built at Darlington this year, and numbered 497, I am told the cylinders of both these engines are 17 by 24, and wheels 5ft. Mr. McDonnell is altering the chimneys of the N.E.R. engines to a pattern somewhat after the Midland style. They are also to be painted an olive brown, with yellow and red lines. If not so "showy," they look handsomer than they used to.—Meteor.

[52298.]—**Bunsen Battery.**—I notice in his directions for making a bichromate battery "Electrician" states that the sulphuric acid should be placed in the cell with the carbon, and the bichromate with the zinc. It may be due to my ignorance, but I certainly fail to see the use of this combination. The bichromate is only used to prevent polarisation by oxidising the hydrogen, which being formed at the zinc is evolved at the carbon plate, and which, unless it is removed, would affect the strength of the current. Firstly, by the increased resistance, as bubbles of gas are bad conductors; secondly, because it sets up an opposite electromotive force, for hydrogen is almost as oxidisable as zinc, and would tend to produce a difference of potential which would start a current in the opposite direction to the true current, and so partially neutralise it. The reason bichromate is not placed in the cell with the zinc is because it attacks it so violently that the plate is very soon eaten away; therefore, in order to obviate this, it is separated from the zinc by a porous cell in which it is placed, together with the carbon, while the zinc is immersed in dilute sulphuric acid. Of course, the bichromate may be placed in the outer cell, but in that case the zinc and acid are in the porous pot. Sulphuric acid has no action on carbon, and cannot oxidise the hydrogen, which oxidation would be effected in its passage through the bichromate. Therefore, it stands to reason that the acid fulfils no useful purpose whatever, and can be dispensed with if used in the manner that "Electrician" proposes. In that case, you might just as well do without the porous cell, and place both plates in the same bichromate solution. Of course, you would have to remove your zinc plates when not in use; but you would have to do the same thing if you made use of the plan as proposed by "Electrician." What you had better do is as follows: I have had batteries in constant use for months for lighting purposes, and can speak from experience. Make a solution of bichromate of potash of the required strength, add to it sufficient strong sulphuric acid to combine with the potash, forming sulphate of potash and free chromic acid, which is a very powerful oxidising substance (or you can use it in the first instance, and in that case you would not follow the latter part of the instructions). Next make a solution of sulphuric acid, and, when cold, add sufficient sulphate of soda until a hydrometer shows it to be of the same specific gravity as the bichromate. Then in a large porous cell place the acid and zinc, and in the other the carbon and bichromate. If this is done properly, you will find that very little bichromate will transfuse. For incandescent lighting, you must couple the cells for quantity—of course, having due regard for the electromotive force required. Two cells, made somewhat in this manner, have lighted two 5-candle lamps for some time without recharging. With respect to Fuller's cell, the only one I know is that which is used in the Post Office, and that is simply an ordinary two-liquid bichromate battery, the outer cell containing the carbon and bichromate, and the porous a cone of zinc in sulphuric acid and water, while at the bottom of the pot some mercury is placed to preserve the amalgamation. This can, however, be achieved by other means, and with more advantage, as metallic mercury is expensive. The best zinc is cheaper in the end, as it lasts longer. Cast zinc should not be used; rolled plates are the best.—William E. Dawson.

[52299.]—**Ice and Skating.**—The ice should certainly always rest on the water, and on a large piece of water it will always do so, even if the water falls in level, except, perhaps, near the edges, where it will slope up to the bank. If such is the case, it is best to break it at the edges, as such unsupported ice over a deep edge is most dangerous. But if the ice is level, and the water close up to it, it is certainly best to leave the edges whole. I know of no worse plan of strapping than that recommended by "T. P." page 289. I tried it myself for a long while. It throws the strain on the arch of the foot, and is very tiring, besides which, the extension of the strap "fore and aft" is mathematically against its holding the skate tightly to the foot, even if strapped tightly. There is nothing like the broad toe-strap, with heel-strap if found necessary.—Guido.

[52302.]—**The Cheapest Food.**—As "Machina" was unable to give "S. R." the name of the pubthird in the same way. It is also a very good plan to apply the solutions of ferro-cyanide of potassium and bichromate of potash to the printed picture with brushes, as these solutions cannot be used again after a print has once been in them. These last two solutions should be allowed to remain on for about a quarter of a minute before washing them off. Be careful to use a different brush for each solution, and also to apply the ferro-cyanide of potassium quickly and evenly, or there will be a mark if it does not touch all the paper nearly at exactly the same time. Remember that the print is not to be washed on coming out of the printing frame; but the ferro-cyanide is to be applied before water touches it. The best light for the dark room is the same as that used to tone silver prints by—namely, diffused daylight. If any other reader of "ours" wants to know anything more about this, I should be happy to give him any further information that I am able.—Machina.

[52372.]—**Chemical.**—The precipitate you obtained is most probably oxychloride of lead ($PbCl_2+PbH_2O_2$). Chloride of lead is not a very soluble salt. At 17·7° water dissolves 0·946 per cent. Pure HCl, 2·90 per cent. It is more soluble in hot solutions. Chloride of lime, Ca(Clo)Cl, dissolves in about 10 parts of water; but the commercial bleaching powder contains a certain amount of lime, which is insoluble. Permanganate oxidises organic matter more powerfully than bichromate, which is not affected. On salts of iron, the action of permanganate is more powerful. The latter parting with more oxygen. The reaction is as follows:—

Bichromate—

$$6FeO + K_2Cr_2O_7 = 3Fe_2O_3 + Cr_2O_3 + K_2O$$

Permanganate—

$$10FeO + 2KMnO_4 = 5Fe_2O_3 + 2MnO + K_2O.$$

—William E. Dawson.

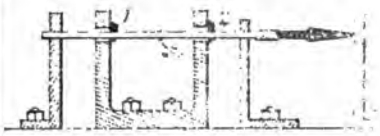
[52390.]—**Dynamo.**—Thanks to "W. H. E." for his answer to my query. I have tested the armature and F.M. I find I have the F.M. all right. I tested the A. with compass-needle, and it gives N. and S. poles in a line with the brushes. The A. is simply a light framework of iron wire to hold the coils in position, and screwed up between two wood ends on a solid steel shaft. I have tried the machine at a little over 1,000, and I find there is magnetism enough to start itself—only very little deflection. Will "W. H. E." kindly say if I am right in my dimensions of wire? Also if my connections to the collector are right, the inner end of one coil and the outer end of the next, following the direction of rotation? Does it matter which way it revolves, so that I connect the positive brush to charge the F.M. always in one direction? Will he kindly say if the fault is due to not having sufficient iron in the armature? I intended to build it with as little iron as possible. I have not run the machine above a minute at once.—Faulty Dynamo.

[52392.]—**Gravitation.**—There is an error in the working of this problem, due either to the querist or to Newth. When correctly done both methods lead to the same result, thus: Space body would traverse by its initial velocity = 120 × 4 = 480ft.; pace due to gravitation in same time = 16 × 16 = 256ft.; difference = 224ft., which is the actual height of the body after 4secs. Adopting the other method, we get time the body would rise is v/g = 3·75secs., in which it would reach 225ft. There would then be left ·25sec., in which it would fall 1ft., making actual height 224ft. as before.—Wm. John Grey, Newcastle-on-Tyne.

[52393.]—**Zinc of Battery.**—There could only one of two things result from gilding: either the zinc would be protected from action, in which case it would be useless; or its consumption would be greatly increased in pure waste. The effect of amalgamation is altogether different: it protects the zinc, and also increases its E.M.F.—Sigma.

[52394.]—**Electrical.**—By gilding your plate you would cover the zinc with a metal on which soda does not act, and, therefore, the solution being unable to attack the plate, you would get no current whatever. A patent was taken out some time ago for gilding zinc plates, but as they afterwards amalgamated them, it only had the effect of removing the gold and leaving a simple mercury amalgamated zinc. You do not want to prevent the action, but waste; because the more it is attacked, the greater the current. If you get pure zinc you will find that they will be more durable. It is the local action arising from impurities in the zinc which causes them to waste so rapidly. Vieille Montagne is the best. I have used it for a long time, and find it answers better than any other.—William E. Dawson.

[52411.]—**Cheap Lathe.**—How would this do? Fasten your headstock on to bed, get two angle-plates with holes ⅜in. or so dia. bored smoothly in them at the height you want your centres to be, bolt the angle-plates on to bed, one at each side of headstock, and pass the bar through holes in plates and holes in casting. The bar should have two small slots in it to fix cutters in, and one end of it should be squared, and a small hole drilled in it. Then bolt another plate behind this, with another shallow hole sunk in it; get a bit of pointed iron—¼in. or $\frac{1}{16}$in. dia. will do—and screw it for a good distance at the opposite end to the point: get another bit, and drill it for a good distance to same size as screw, tap it, and point opposite end. This outer sheath should be squared to fit a spanner same as boring-bar. Then put one point into hole in bar, and the other into hole in plate, and screw out sheath so as to press the cutters to the job, and then turn boring-bar, tightening it up occasionally by screw. The illustration shows all clearly if Editor cares to put it in.—George Pardoe.



[52413.]—**G. N. Engines.**—The last lot of 8ft. singles, No. 662-671, were started in 1880, and 671 came out at the beginning of this year. Since then, none have been built. I have no further dimensions of the coupled engines than cylinders 17½ by 26, and coupled wheels 6ft. 7½in.—Meteor.

[52418.] – **Photographing in Natural Colours.**—A series of these productions was exhibited at the Royal Society's conversazione about three years ago. The prints are really multi-coloured Woodburytypes. The method is as follows:—Several zinc matrices are made, each containing a part of the picture of a uniform colour, such as a sky, the green foliage of trees, grass, &c., the browns of dead leaves, earth, &c., and so on. The next step is the same as pursued in chromo-lithographing. The only superiority of these photo-chromographs being that the forms are an exact reproduction of Nature coupled with artistic colouring.—P. Ward.

[52426.]—**Chloride of Zinc and Manganese Battery.**—I do not think it is as good as when charged with sal-ammoniac: it will have lower force and lower capacity for current, and will be of use only for very small currents.—Sigma.

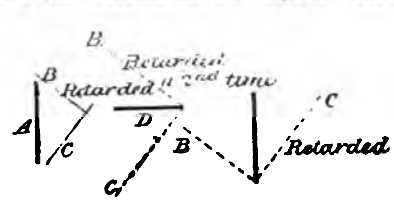
[52433.]—**M.R. Engines.**—To "Historian, M.I.M.E."—No. 45 was built in 1874 at Derby, and was rebuilt in 1876. The coupled wheels are 6ft. 8½in. in diameter, and cylinders 17 by 24. The engine has inside frames to coupled wheels, and outside to leading. It is stationed at Sheffield. 133, a single engine, was built by Stephenson, 1852. There were 6 engines of the class: Nos. 130—136. 130 was renumbered as No. 4, and most of the others are on "A" list. They have 6ft. 8in. wheels, and cylinders were (when the engine was built) 16 by 22. It was rebuilt in 1875, and possibly larger cylinders were put in. 142 and 145 were 4-coupled (leaders), trailing bogie, side tanks, built at Derby in 1875 for Metropolitan traffic, for which they are fitted with condensers. They have 5ft. 6in. coupled wheels, and cylinders 17 by 24. They are in most respects like 1252–1281 class (by Neilson and Co.), but the latter have covered-in cabs. I have the dimensions of 1252 class, which, if "Historian" likes, I can give. I believe 142 class are same. 119 is a 6ft. 8in. single engine, rebuilt 1875. It was stationed at Lancaster for many years; but I do not know where it is now. I have no further particulars of this engine. 129 is (or was) also a single engine at Birmingham; but I have not heard anything of it for some time. The Midland single engines, as originally built, had 16in., and 16½in. by 22in. cylinders at first, and the later classes (31 and 97 classes) 16½ by 24. In a back volume, Mr. Stretton stated that three had been rebuilt with 17 by 24 cylinders. I do not know which; possibly Mr. Stretton will oblige with the numbers. Mr. Johnson has rebuilt several with large boilers, and they now are splendid engines. I believe, when rebuilt, the trailing wheels had additional weight put on to them. Can anyone say whether Mr. Johnson has put larger cylinders into those rebuilt—e.g., 33, 36, 39, 24, 97—100, &c.? The weight of the original 130 class (Stephenson's) was:—Leading wheels 10 tons, driving wheels 12 ton 3cwt., trailing wheels 5 tons 17cwt., total 28 tons.—Meteor.

[52435.]—**Extraordinary Phenomenon.**—May not the following be a solution? The electric state of the atmosphere has lately been at very high tension, necessitating a difference of temperature in various layers of the air, and consequently different degrees of degrees of density. The rays from the sun (when setting or rising) striking obliquely on the layers of different densities cause different degrees of refraction, and the watery vapour dispersing the rays (as through a prism) cause the colours to appear at varying distances from each other.—Electricum.

[52435.]—**Extraordinary Phenomena.**—I make the word plural, because evenings and mornings for the past several weeks the appearance of the sky has continually varied—one evening a furious red glow, far up towards the zenith, and beyond the west point of the horizon; next evening the glow, more of an orange tint, towards the south, and extending a good way eastward; another a spreading mass of flaming red, behind which glowed bright yellow and orange light, just as described in a newspaper letter from Athens the same week, perhaps the very same day of the month. The "sea-green tint" mentioned by "Hammer" was very remarkable here (extreme South Lancashire), so that the crescent moon shared it, and caused several of my acquaintances to revert to our old nursery legend about "green cheese." But surely "Nun. Dor." is *poking fun* at "us" when he suggests that the seeing of wonderful colours is due to the "colour-blindness" of the *seers!*—H. O'B.

[52440.]—**Water Power.**—A turbine will give the power if there is sufficient water. One horse-power requires about 31 cubic feet, or 194 gallons of water per minute at 24ft. fall. It would require a very extra large spring to give the quantity which of running quietly over a sill 1ft. wide would have a depth of about 3¾in.—J. Brown, Belfast.

[52442.] — **Complementary Colours in Polariscope.**—Most, if not all, the textbooks pass over this with "of course." I will endeavour to make it plain with the aid of a diagram. A is the plane of vibration of the beam of light on emergence from the first Nicol; BC represents the two planes into which this is divided by the double refracting selenite, the vibrations in B being retarded more than in C, and consequently a portion of a vibration behind; D is the plane of vibration of a crossed Nicol, and the dotted lines indicate how the light in the two planes of the selenite impinges upon the Nicol. These rays enter the second Nicol prism at right angles to each other, and consequently are again one retarded more than the other during their passage and resolution into a single plane. If the beam B again is most retarded, we have a double retardation while the prisms are crossed, but when D is rotated to E, and the prisms are made parallel, the plane B is necessarily on the other side of the plane of vibration of the Nicol; therefore the light travels more quickly in it, and C becomes the more retarded beam. Thus the difference in the phase of vibration is in one case an addition of retardation, and in the other difference of retardations. If the thickness of the film of selenite is such that the doubled retardation is half a wave-length of red, then the red is extinguished, and the complementary colours remain. Upon rotating the prisms, the retardations being mutually corrective to a certain extent, we have a shorter total retardation, consequently the shorter waves will now interfere, and the longer red remain. I have supposed the whole effect produced by the analysing prism, whereas it is really the effect of analyser and polariser combined. I think, however, anyone who has mastered thus much will have no difficulty in applying the principle to the resolution of the polariser instead of the analyser, and so comprehending the whole. I may as well add that the beautiful colours visible by polarised light are not pure, but always more or less mixed.—Edwin Holmes.



[52443.]—**Overworked Brain.**—I do not prescribe for "B. M.," I only make some suggestions. We all receive the seventh-day rest as a blessing for body and mind, and also on the score of economy. Why not accord the same rest to the stomach? The fast day need not be on Friday, but according to circumstances. An old-fashioned thinker advises a bread-and-cheese dinner once a week as an adjunct to good health; but this would not give the stomach rest. When we feel ill we send for those nasty bilious pills or castor oil, that always have a sickening reaction. By practising total abstinence from all diet, we can rapidly reduce the bile to submission, and act as nature intends. Supper is an abominable institution to precede sleep, perchance to dream, and more honoured in the breach than observance. I am rather inclined to think, then, that a fast day is of more benefit than our modern Gargantuas are inclined to admit.—Fiddler.

[52444.]—**Electric Current.**—It would be generated if the wire were wound upon the steel [illegible] The telephone [illegible]

[52411.]—**Greek Inscription.**—If "Student" [illegible] would probably find the inscription [illegible] Mure's Critical History of the Language and Literature of Ancient Greece, [illegible] the tablet in question, [illegible] the Digamma, he writes [illegible] Digamma [illegible] of the words known to have been susceptible of digamma [illegible] III., p. 51; "I write the words in Roman characters; I cannot say where a translation of the inscription is to be found." [illegible]

[52419.]—**Greek Inscription.**—The inscription referred to by "Student" on a brazen tablet relates to a treaty between the Eleans and the Heræans, entered into, as Mr Payne Knight conjectures, about the period of the XLth Olympiad, which would be B.C. 620. It has the advantage of being the most ancient inscription ever copied in Greece, or brought to this country, and is also one of the most important for illustrating the use of the Digamma. The nature of the inscription does not appear, but reference to it may be found perhaps in the work of Colonel Leake on "The Morea" (a work possibly in the British Museum Library, or at the Guildhall). The tablet itself is in the British Museum; it is therefore possible that full particulars concerning it may be obtained through that source.—Geo. H. Lancaster.

[52454.]—**Butcher's Ice Room.**—Make a skeleton of deal 3in. square, of any dimensions, with door not less than 12in. from bottom, the top to extend higher than door, to leave room for ice in chamber at top on a shelf, leaving space all round same with fillet about 1in. all round, and pipe from same leading melted ice-water to bottom. The top lid may be single, but must fit well. A small hole at top is desirable for ventilation. All sides and bottom may be matched lining, and filled in with any non-conducting material, as very dry sawdust, hair, felt, such as builders use, or powdered charcoal, the last being the best. There must also be an outlet at bottom for getting rid of condensed water; it must be trapped, to prevent the [illegible] running away also.—Arit.

[52455.]—**Shaft Journal.**—A rule given by Jno. Bourne is "Divide the number 70,000 by the velocity of the surface of the bearing in feet per minute. The quotient will be the number of pounds per square inch of section in the line of the axis, that may be put upon the bearing." The diameter multiplied by the length is the surface upon which the pressure is reckoned.—W. J.

[52458.]—**Electrophorus.**—The holes are evidently to blame, though I don't quite see how. Perhaps the electricity escapes through the holes in the [illegible] and [illegible] at the moment of lifting up.—F. A. R. Bennett.

[524..]—**Electric Lighting.**—It is quite possible to arrange a dynamo machine to work both arc and incandescent lamps from the same machine, but not in the same circuit satisfactorily. If [illegible] will address [illegible] me, I shall be pleased to help him to use his power to best advantage. [illegible] he has not constructed a dynamo [illegible] I fear that in attempting it he will cause [illegible]—F. M. Rogers.

[illegible]

[524..]—**Transmission in Cables.**—[illegible]

[524..]—**Casting Lead.**—[illegible]

[524..]—**Casting Lead.**—[illegible]

[524..]—**Transmission of Power by Electricity.**—[illegible]

[illegible] want a 20ft. [illegible] dynamo and [illegible] at the works [illegible]

[524..]—**Belt Working off Pulley.**—If your shafts are running true and parallel with each other and [illegible] and pulley square with shafting, the only thing left for you to do is to turn off a [illegible] from pulley, leaving the centre stand above the sides [illegible] the effect of shrinking, or rather [illegible] on pulley a [illegible] ring of small rope, [illegible] centre.—Wm. Hosken.

[52465.]—**Belt Working off Pulley.**—If this querist will see that both his shafts are quite parallel, and the drum and pulley in a line, and yet some leather strips about ½in. wide, carefully reduced in thickness on each edge: nail it on the centre of the pulley (if wood); if iron, he must drill holes for small bolts. We have no trouble at our works with 3in. belts; although we have no flanges, we always make the pulley faces convex.—Bad Vacuum.

[52465.]—**Belt Working off Pulley.**—As a machinist, you are just a trifle behind the times, since flanges have long since been abolished as a means of keeping belts on pulleys. Both your queries refer to the same defect—viz., the shafts are not fixed parallel to each other. The remedy is, first see that the shafts are level; if, after doing so, the belts still have a tendency to run off, move them further apart at that end which the belt has a tendency to run to.—W. J.

[52465.]—**Belt Working off Pulley.**—The pulleys may not be in line, or the shafts may be unlevel, or they may be nearer to each other at one end than the other. To prove if the pulleys are in line, take a string and hold one end at the side of the pulley so as to cross its diameter as near the centre as possible, while your assistant holds the other end across the other pulley. If the string is tight and the shafts are in line, the string ought to touch both wheels on their edges. If it only touches one edge of each wheel, it shows the shafts are not parallel. The same effect will be caused if the shafts are out of level. Try a spirit level on each shaft. Lastly, your pulley ought to be ⅛in. higher in the centre of the rim, rising gradually from each edge. Proved.—W. W.

[52466.]—**Cross Belts.**—Leather belts would be best.—Bad Vacuum.

[52466.]—**Cross Belts.**—To repeat an old saying, "There is nothing like leather," a 4½in. leather belt will do better than a 6in. cotton one, especially if crossed. Be careful not to have any lumps at fastening, but butt ends of belt, and do not allow points of fasteners to come through.—Wm. Hosken.

[52470.]—**Malting and Malt-Kilns.**—Please to understand that it is rather difficult to instruct you on paper how to make malt, but I will do my best. Take a tub holding more than the quantity of barley to be steeped, into which shoot the barley, and cover it about 4in. deep with water. Steep 60 hours, then drain the water off, and throw the barley out on the floor in a level heap, about 1ft. thick, more or less, according to the temperature of the air. Let it be till it begins to grow, then spread it out thinner (about 6in. thick). When the rootlets are about ½in. in length spread it out evenly, about 4in. thick: this is called turning the floor. If on taking a few grains up they hold together by their roots the floor must be turned again. When the acrospire or plumule has grown [illegible] the way up the grain it is ready for the kiln. Put the floor about [illegible] thick, the last time you turn it before placing on the kiln. Now as to kiln. The drying floors are usually constructed of tiles, wire, and sometimes iron plates pierced with holes. I suppose you will have the last, as kiln tiles may not be obtainable in [illegible] A kiln about [illegible] square will dry that quantity you name. Let the plates be [illegible] from the fire. Arrange a baffle plate over the fire, about [illegible] below the pierced plates, and you must be able to regulate the draught. [illegible] [illegible]

[524..]—**Sailing.**—[illegible]

[524..]—**Ferro-Manganese.**—[illegible] of iron and manganese [illegible] carbon [illegible] and manganese; but at present there is no direct evidence of such a combination. Spiegeleisen is a similar compound to ferro-manganese, only contains much less manganese, and may possibly be a double carbide of iron and manganese. Some chemists regard the combined carbon in white irons, ferro, &c., as a solution of the carbon in the iron—i.e., it is simply dissolved in the iron, and no chemical combination. In the Bessemer process, as conducted in this country, the whole of the carbon, as well as the Mn, is removed during the blow, and spiegel or ferro is added at end to give required amount of C to the steel, without which it would be unworkable. The carbon and manganese probably also act together to reduce any small amounts of oxide of iron formed to metallic iron again, which, if present, destroys the malleability of the steel. It is necessary to have some manganese in all good steel, as without it the metal becomes brittle; but how it acts, whether by forming an alloy, or by combining chemically with the carbon, is not determined. Manganese is also said to prevent honeycomb, and give sounder ingots. The action of ferro is same in Siemens as in Bessemer.—Ferro.

[52478.]—**Whitewashing.**—Common glue dissolved in water till of the consistence of jelly when cold; but being made by the glue manufacturer from refuse matter, can be bought cheaper than made on a small scale. About a bowlful is used to a bucketful of colour wash.—H. J. Sayer.

[52478.]—**Whitewashing.**—It is simply size, made by boiling cuttings of skins, &c., but you can use glue, if you prefer. The quantity depends on how thick you want the wash. To make that, steep whiting in plenty of water; pour off the water, and mash the whiting up to a smooth paste. Now put some size in a kettle over the fire, and when thoroughly melted stir into your whiting, add blue to taste, and there you are. About two pounds of size is sufficient for six balls of whiting. That is the common whitewash. For fine work some use rice flour in addition to the size or glue.—Nux. Dor.

[52479.]—**Electric Clock.**—The following hints may prove useful to you. You say your clock strikes: it cannot do this without a hammer. Now, what is easier than to connect the positive pole of the battery to the brass frame of the clock? Next, secure a piece of ¼in. flat ebonite to the clock, near to the hammer-stem; to this ebonite screw a thin but strong German-silver spring, this spring not touching the hammer-stem except when the clock is striking; connect this spring to the one end of the bell-coils; the other end of the bell-coils connect to the negative pole of the battery. Now, when the clock-hammer goes to strike, it rises and comes in contact with the German-silver spring, thus completing the electric circuit. As the hammer of the clock falls the armature of the bell also falls, only to rise again when the clock strikes. Two No. 2 Leclanché cells work admirably.—E. A. Barnes.

[52479.]—**Electric Clock.**—I have had a clock going for eighteen months that strikes the hours on its own bell, and on a single-stroke electric bell in another part of house. I also fitted my clock with alarm arrangement to ring vibrating electric bell in still another part of my house. The striking arrangement was accomplished by attaching a piece of brass wire at right angles to the hammer of clock bell, and bent so as to lightly touch a spring stub each time the clock struck, thus making contact. The spring stub is constructed so that it can be screwed either closer or further from the wire attached to clock hammer for adjustment. The alarm arrangement is similar to ordinary clock alarm [illegible] [illegible]

[524..]—**Electric Bell.**—[illegible]

[524..]—**Income Tax.**—[illegible]

[524..]—**Income Tax.**—[illegible]

[illegible]

[illegible]—**[illegible] Horse Power.**—[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] suggestion, we then washed and dried the plate, and returned it to the dark slide. Next morning we exposed again for a [illegible] of a second to the view from [illegible] window [illegible] daylight, and redeveloped. [illegible] in two minutes the view was fully out, and a tolerably dense negative was the result. Not a trace could be seen of the room on it. Is it to be assumed from this that ten minutes' exposure with the [illegible] and a very rapid lens, leaves an instantaneous plate unaffected? It seems so, and yet is hard to believe. Have any of your readers had a similar experiment? It appears, also, that even prolonged treatment with the developer does not impair the sensitiveness of a plate [illegible] not been affected by light. Is this conclusion [illegible]—A. T. Hall.

[illegible]—**Laboratory for Ironworks.**—Will some correspondent kindly give a small sketch of above, suitable for works having four blast furnaces? Size [illegible] to be about 25ft. by [illegible]. Also, any hints [illegible] will much oblige.—[illegible]

[illegible]—**Pivot.**—I want to replace new balance, as [illegible] badly damaged. Will any reader kindly [illegible] without injury to [illegible] against top of [illegible]

[illegible]—**Sections of Ironwork.**—Will you or any [illegible] readers kindly favour me with [illegible] Example: How [illegible]

[illegible]—**Long Focus Telescopes.**—[illegible] power. [illegible]

[illegible]—**Photographic Rolling Machine.**—Can any of your readers [illegible] explain how to make the above, and also give a rough sketch of same [illegible]

[illegible]—**Micro-Photography.**—Will some kind [illegible] which [illegible] I have [illegible] myself [illegible] to make a photographic [illegible] dry plates [illegible] I [illegible] Micro-Photography [illegible] better.—[illegible]

Measurement of Curvature of Lenses.—At a recent meeting of the Physical Society, Professor [illegible] read a paper on "The Measurement of the Curvature of Lenses." [illegible] the spherometer cannot be [illegible] the method is based on the Newton's rings formed between the lens and a plain surface, or a curved surface of known radius. From the wave-length of the light employed in observing and the diameter of a ring, the radius of curvature can be determined. He places the lens on a plane or curved surface under a micro-scope, and lights it by the sodium flame—wave-length [illegible]—he measures the approximate diameters of two rings a distance apart—in practice the tenth and twentieth rings are found convenient—takes the difference of their squares, and divides [illegible] the wave-length and the number of rings in the gap between to find the radius of the lens. The formula is—

[illegible]

where [illegible] and [illegible] are the diameters of the [illegible] and [illegible] rings, [illegible] the wave-length of the light and [illegible] the radius of curvature of the lens. The method with proper care gives accurate results. Professor [illegible] has also used it to determine the refractive index of liquids in small quantities. Mr. [illegible] having found it for water = [illegible] by this method, which is usually correct to two places of decimals. It can also be used to determine if the lens is uniformly curved and spherical.

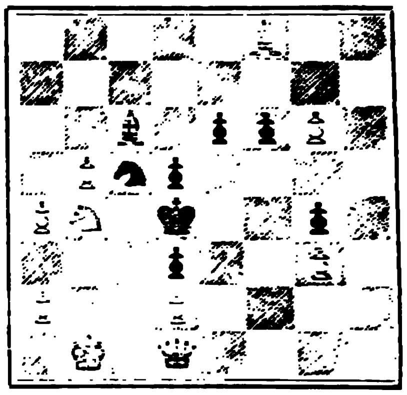
Twin Steamer for the Gaboon.—At the [illegible] trial of the little twin steamship [illegible] the Mersey, a speed of 8 knots was attained with [illegible] draught of [illegible]. The vessel, which is built of steel, is [illegible] long, [illegible] beam, and [illegible] deep, with raised forecastle, and deck-house amidships. She is fitted with [illegible] engines, having cylinders [illegible] fitted with a wrought iron [illegible] separate engine for air and circulating pumps. The [illegible] throughout. The vessel and machinery were built for service on the [illegible] of the West Coast of Africa.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXVI.—By C. Planck.

Black.



White. [11–7]

White to play and mate in three moves.

Solution to 864.

White.	Black.
1. [illegible] B [illegible]	1. K moves [illegible]
2. [illegible] Kt [illegible]	2. Anything
3. [illegible] mates accordingly	
	If 1. P-Kt 6
2. [illegible] takes P [illegible]	2. Anything
3. [illegible] mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 863 by Rev. W. Anderson (Old Romney), J. [illegible] Boxford, and Lucky Sam; to 864 by J. B. [illegible] Boxford, Lucky Sam, E. Stanley Follwell [illegible] Black has no [illegible] at all), A. Schmucke, and F. A. Bennett.

The New Year's number of the [illegible] Magazine will [illegible] with a photograph of the Editor, and [illegible] executed in the highest style of art. The extra charge will be 1s. 6d. or [illegible]—according to the size. We are told that "the circulation of the magazine has steadily increased during the year, and was never so large as it is at present." Now is the time for any of our readers to become subscribers if they are not already. The subscription, payable in advance, is [illegible] a year, to be sent to J. Watkinson, Fairfield, Huddersfield.

English Mechanic Tourney game between Messrs. Russell (White) and Vincent (Black):—

Scotch Gambit.

1. P-K 4, P-K 4 2. Kt-K B 3, Kt-Q B 3 3. P-Q 4, P takes P 4. Kt takes P, B-B 4 5. B-K 3, Q-B 3 6. P-Q B 3, K Kt-K 2 7. Q-Q 2, Q-Kt 3 (a) 8. Kt-Kt 5, P takes B [illegible] takes B, K-Q sq 10. Kt-Q 2, P-B 4 [illegible] 12. Kt-Q 4, P-Q 3 [illegible] Kt-K 4 14. B-B 2 [illegible] P takes P 15. Kt takes P [illegible] Kt-Q 4 [illegible] Q-Kt 5 ch, K-K sq [illegible] P takes Q [illegible] 18. Kt-K 6 [illegible] 19. R-Q 8 ch, K-B 2 [illegible] Q takes Kt ch 21. Kt takes Q [illegible] Kt-K 4 [illegible] K-B 2 23. R takes R and wins.

Notes.

(a) [illegible] a novelty, but its soundness is questionable.

[illegible] K sq is more to the purpose.

White might also have played P-K 5.

[illegible] P-Q 3 would be better.

[illegible] White has now a fine game, helped [illegible] by Black's [illegible] move.

[illegible] White's game. R-K B sq is stronger.

[illegible] after combination, which the [illegible] to have seen through.

[illegible] have taken with the Q, as it is [illegible] in the way of the double [illegible]

[illegible] played.

[illegible] number two game.

A very pretty game, with a charming ending.

Top Dressing for Lawn.—Instead of top dressing a lawn with stable manure every fall, and then raking it off in the spring, as in the usual custom, [illegible] correspondent, try sowing broadcast in the fall [illegible] pounds to the acre of finely ground raw bone meal and an equal weight of refuse salt from the [illegible] packing establishments, and [illegible] gypsum (land plaster). Then scatter on the surface at least half an inch of good, rich [illegible] sow at the rate of two bushels of blue grass seed to the acre, and give it a thorough raking and then roll it, and you will have no further trouble with your lawn, no matter how dry the season may be.

such shoulder as that of a tenon that may need to be so pared, and, of course, the same is true of the mortise, of which the ends (across the grain) are always cut with a chisel. If proof is further needed, let such mortise be carefully marked on both sides, but cut right through from one side only. The chances are that it will be found to have been cut too long on the further side of the stuff from this drawing in of the chisel. The section will be that of A, Fig. 14. Of course, therefore, the safe plan when a mortise *must* be cut only from one side is to cut it more like B, and to pare it back carefully at the finish. Whenever possible, however, a mortise should always be cut from both sides—half through from each; but the same tendency of course prevails, the result being shown in C, and here the faulty work will not be visible in the least when the tenon is in its place. The joint will appear quite close fitting and neat, but it is evident that it will have little strength, as the component parts are only in contact just at the two surfaces, the rest being quite hollow. The best way to begin a mortise is shown at D. It should be commenced by cutting out wedge-shaped chips from the middle, cutting each side by turns, and it will be found in many cases easier to take out the main part of the chips with the bevel of the chisel downwards. Each chip is thus heaved by pressing on the bevel as the fulcrum, and the mortise is gradually lengthened each way. After the main part of the wood has been removed, the back of the chisel is used next the shoulders, as already stated, care being taken, as the work approaches completion, that the hole is not undercut, but that the mortise, when finished, shall have four perfectly flat walls, the sides as free, also, as possible, from loose fibres.

Only one more cause of failure need be mentioned, and that is the bruising of the fibres on the surface of the board at the ends of the mortise by using a blunt chisel. It is mainly avoided by commencing in the middle, as just explained, but chiefly by using a keen chisel to finish with. It is true that the work may be, and very generally is, planed over again after the mortise has been cut; but that is an operation quite as well avoided, as it is seldom allowed for in squaring up the piece at the commencement. In soft wood, especially where the fibres are loosely compacted, they will bruise, and start up considerably if struck with a blunt tool, and often come completely away, leaving a depression that cannot be effaced without deeply planing the surface. All such accidents are fatal to close joints, and betoken either want of skill, or, which is even more common, want of care on the part of the workman. The surface of the bench, too, is often terribly knocked about and untrue; and when a bit of clean soft wood is laid upon it, and then mortised or otherwise worked upon by a chisel struck by a mallet, it takes the impression of these bruises and inequalities. But chips, and possibly unnoticed tacks, are the main enemies to neatness which are to be dreaded. By way of an example of more difficult fitting, it sometimes happens that the mortise is cut in a piece of hexagonal form, or other section of that nature, and that a rail has to be fitted in which the shoulders of the tenon must be so made as to embrace the parts about the mortise. Fig. 15, A and B, represents such. The shoulders *a*, *b* are specially difficult to pare, owing to the angular direction of the grain, as the natural way of cutting such a surface smoothly would be to work from *x* to *y* of C, and this cannot be done in this case. It may be pared with a chisel more readily when laid down on its side, as at D, the chisel cutting perpendicularly; but the angles frequently prohibit the chisel from cutting into them closely. Still, there is no help for it, and there is no job which requires a sharper tool deftly managed. When the work is small, the finest saw, used carefully, may suffice without any subsequent paring, and is the safer tool to use. When however, the parts are to be constructed of wood of more than usually curled grain, it may suffice to cut a recess into what I may call the standard, to receive the hexagonal rail itself beyond its tenon, Fig. 16, A, B, and C, where the mortise is shown quite black, and the recess is shaded. Neatly done, the effect is the same as when the shoulders are cut, as in the previous case; but allowance must be made in the length of the rail, or it will, of course, be too short when fitted into its place. The first plan, even if well done, is not so strong as the second, and in an out-door job where exposed the latter would be far less liable to admit rain to injure the tenon; but there are many cases in which the same kind of fitting is needed where a plan similar to that first described is essential. Of all simple jobs a half-lap joint again is apparently one of the simplest, yet is one very often badly made. Each of the pieces has three surfaces in contact—viz., the broad face A of Fig. 17, the side *a d*, the front *a b*, corresponding to similar ones on B, to which it is supposed to be necessary to attach it at right angles. As a joint it has no strength, however well made; but it is of very frequent use in stuff of all sizes, and is used not only to join one piece at right angles (or at some intermediate angle) to another, but also to join them lengthwise. The line *a b* must be accurately scribed with the help of a square, and, with the same appliance, the line answering to *c d* of B must be marked round three sides of each piece. Then, with a marking gauge, *e f* and its counterpart, which, together, determine the plane of the part A, is set off, and this line is carried along the end *g h*. On white wood, a finely-pointed (or finely *edged*) pencil will make a better line. Now, it is here that amateurs are apt to be lazy. They mark perhaps *a b*, saw down a shoulder, with no further guide line, and holding a broad chisel at the end, hit it with a mallet, and off goes the whole cheek piece, leaving possibly a fairly true face, and more generally a very *untrue* one—so untrue frequently that no subsequent paring will correct it. But as it will be much concealed from view it is allowed to pass muster, and a nice botched job it makes.

Now, supposing this, intended as it often is, to be a glued joint, the great object to be aimed at is to make each face as level and true as possible, so as to provide plenty of surface contact. We may, in this way even make the half-lap joint strong enough. Hence it is essentially necessary to scribe all lines with accuracy, and then to cut precisely up to them. The cutting across the grain will, of course, be done by the tenon saw, which will be carried down to the line *gauged* to show the line *e f* marking the position of the half-thickness of the stuff. Then the work should be stood end up in the vice, and the cheek-piece carefully removed, leaving the surface, if possible, so flat and true as not to need subsequent dressing with the chisel. A *small* hand saw will do this best, its teeth set out only just so far as to prevent the blade from binding in the cut. A saw known as a panel saw will do this nicely; a large hand-saw with much set is far more difficult to use. Every tendency to encroach on the guide-lines, so as to undercut the work like D of this Fig., must be avoided and resisted to the utmost, because if the cut once takes that direction it will end too deep, making a misfit that cannot be rectified. The main secrets, it will be seen, of making close joints are, first, to mark every line with care; secondly, to cut accurately up to them, but not to efface them; and, have saws and chisels in perfect does not take long to learn to do but the second and third require good deal of practice, but a patien mination to succeed, and never account to slur over or hurry the ever unimportant it may appear to

O. J.

ELECTRO-MAGNETS.

By J. T. SPRAGUE.

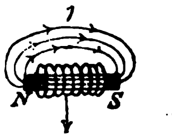
THERE is still some confusion meaning of the "strength of a and the various terms, "magnet ment," "free magnetism," "magnet and "lifting power." It is not deal with these subjects here, except as is necessary to explain the electro-magnets, but it is essential clear the distinction between strength and lifting power.

1. The *strength of a pole* is measured the field it can set up; by the repellent force it can exert upon magnet, and the unit strength of which at one centimetre distance similar and equal pole with a force dyne.

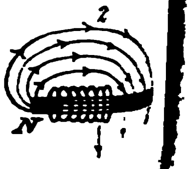
2. Now the essential feature of is its equal opposite dualism: magnet there are equal N. and present; in every magnet there N. and S. end, and in some sense S. pole; but it by no means the two ends of, say, a bar magnet stitute *two poles of equal stren* pole may be stronger than the withstanding the equal opposite netism.

3. Taking a bar magnet, netised throughout, and having opposite N. and S. poles, either capable of lifting a fixed weight— let the bar be turned into a horse- it will no longer lift only the its two poles, but several times Lifting power, therefore, depends thing besides "magnetic depends upon the arrangement or really upon how much of magnetic force is concentrated armature by which the lifting exerted. Figs. 1 and 2 will

1

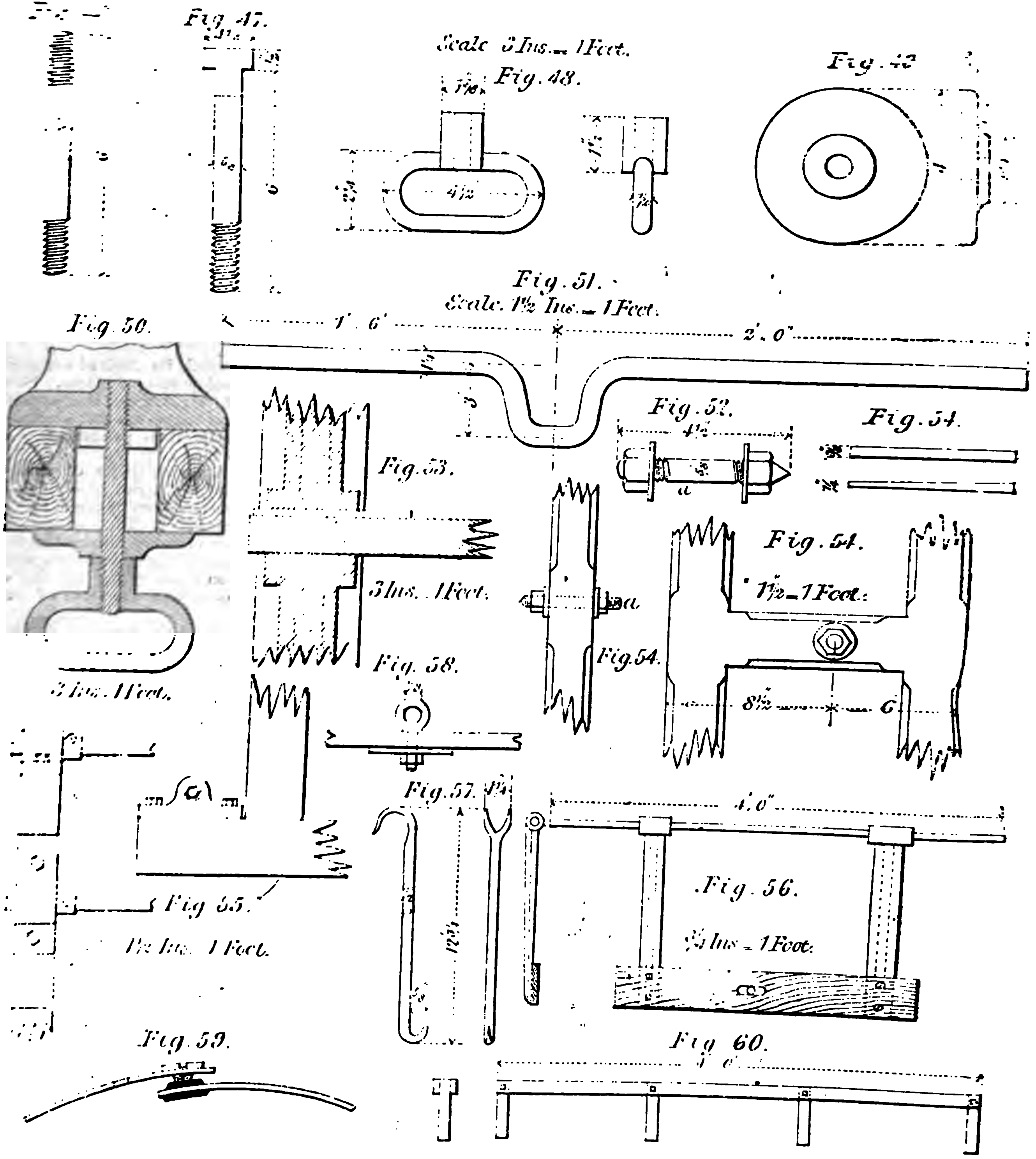


2



relations. Fig. 1 is a bar of helix over its whole length, magnetism throughout, and equal N. and S. poles. Now, that pole N. can hold up 1oz. such a current passes as satur §§ 15, we can make it hold a with the same current by adding iron to the S. end. We can we have increased the *magnetic* the system. Fig. 2 represents attained in a different way, that is longer core to the same helix. have no longer equal magnetism the core; we have equal N. and S. truly; but the middle or neutral magnet would no longer be at the the bar, but brought considerably the N. end; therefore, the N. pole stronger than the S. pole, and would greater weight, because the lines of netic force are of necessity more trated at that end.

4. The action of the horseshoe that of the straight bar, so far as its



[illegible] for the key. To turn the portion of the crank, round which the loop of the connecting rod fits would be a troublesome job for an amateur, requiring a couple of chucking [illegible] plates on the ends to bring the [illegible] in line with the lathe centres. The [illegible] method, therefore, will be to file this portion approximately circular, checking with a [illegible] metal templet from time to time.

[illegible] fit on the turned end of the [illegible] too large for your lathe, get it [illegible] way ⅝in. by ¼in. A turned rim [illegible] appearance, but is not an essential, so [illegible] for the work, or the [illegible], may influence your decision [illegible] Fig. 52, and key wheel on axle, [illegible]

[illegible] for the crank-axle, Fig. 54, [illegible] Two pieces of ⅝in. rod, 4¼in. [illegible] down at one end as shown, [illegible] for chucking, as was the [illegible] turning. Screw with stock [illegible] each end, and have the [illegible] nuts and washers. [illegible] in the middle rail [illegible] somewhat out of centre, Fig. [illegible] and screw them up moderately tight into the countersunk ends of the crank axle.

For the treadle bar get a piece of ¾in. gas tubing 4ft. long, and either skim in the lathe, or file the ends to a fairly decent fit into the bearings cast for their reception; grinding both bar and bearing together with a little fine emery and oil at the finish will facilitate the easy motion of the bar. We want to keep the bar in position endways. A couple of collars furnish the readiest method of doing so. Turn two metal rings, 1in. in the hole, 1in. long by ¼in. thick, or simply two pieces 1in. long, cut from 1in. gaspipe, will answer the purpose sufficiently well. Into each of these collars tap a ¼in. set screw, by which to hold them in position on the bar. Drill two holes in each bearing for wood screws, slip the bearings over the ends of the bar, and screw in position on standards, Fig. 55.

Now, temporarily slipping one of the end bearings off, take out the bar again, and fit to it the carriers for the treadle board. Cast an inch hole through the bosses of these, and they ought to fit just tight over the ¾in. gas tube without much filing. We must cut a key-way in each boss ¼in. wide by $\frac{3}{16}$in deep, and make keys to correspond; also flats on the treadle-bar. Drill besides a couple of holes for wood scr for fixing the treadle board; then key up, a replace bar permanently in bearings. Prepar piece of board 2ft. 6in. by 4in. by 1in., a screw in place. The treadle, now complete, h the appearance of Fig. 56.

Have the connecting rod forged to dimensio (Fig. 57). Rig up a chain and wheel if yo prefer it; but the rod is easier made, and answe well enough. Loop the rod into a ⅜in. eye bo let into the treadle board, having a washe between the nut and the wood (Fig. 58).

We may now consider the actual lathe a finished. The chucks we prefer to regard a accessories, and to discuss in a chapter devote specially to them.

For driving, get a piece of leather belting at a saddler's, ⅞in. or 1in. wide, by 8ft. 9in. long, an fasten at the ends with a common band screw No. 1 or 2. In a foot lathe, the removal of th strap from one speed to another is not so ofte necessary as in one driven by steam power, be cause the speed can be regulated within a wi range by the foot of the individual who treading. Hence, our driving wheel of one spe only will seldom put us to the inconvenience having to alter the length of strap. Then, ho

Fig. 1.

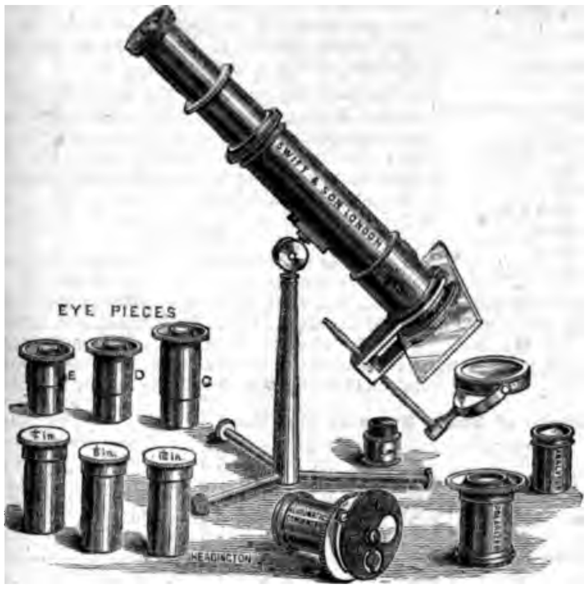
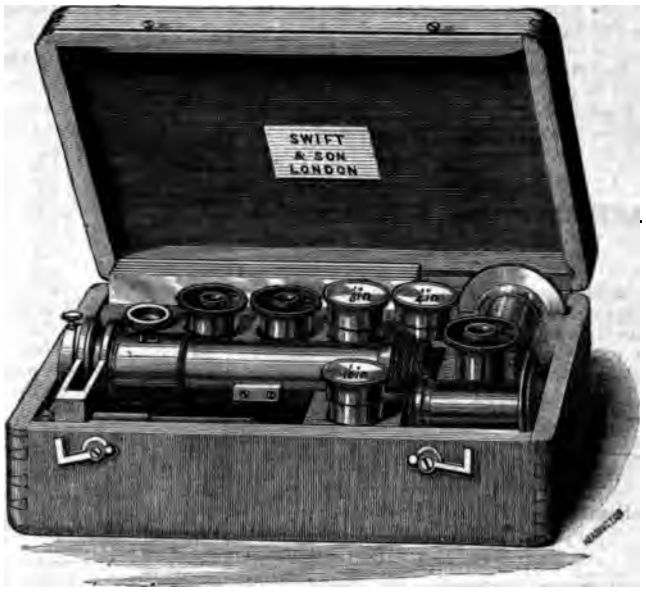


Fig. 2.



ever, the adjustment can be effected in a few seconds by removing the screw from one pair of holes to the other (Fig. 59).

A tool rack is a convenient accessory to a lathe. Prepare two strips of wood 4ft. long by 1in. by ⅜in., and screw them to four vertical strips 6in. by 1in. by ⅛in., the lower ends of which are to be screwed to the bar at the back (Fig. 60). A tool board also 4ft. by 9 by ½in. screwed on the top edges of the standards receives the tools and odds and ends of material which we have in use when working at the lathe.

In counting the cost, let it be noted that prices will vary, and the experience of no two persons will be exactly alike. But the figures we state will be found approximately correct.

The crank is the most expensive item. A piece of 1¼in. round bar iron, 4ft. long, will weigh 16½lb., which, at 1½d. per lb., will cost a couple of shillings. A smith will forge it for 3s. Then poppet, mandrels, screws, bolts, dead centres for crank, nuts, should not cost more than 5s. Another 1s. 6d. will pay for the three cast-iron washers and tightening nuts, and the strap at 3d. per foot will run to 2s. 3d. The bit of timber for tool board, rack, and treadle, about a shilling. Gas tubing at 4d. per foot, 1s. 4d.; total 16s. 1d.

This supposes that every little bit of wood and metal has to be bought; but odds and ends of wrought bar and strips of wood may often be had for the asking, and waste material may often be utilised, so that if we put the cost of these miscellaneous items at 15s., we shall not be out of pocket by our estimate.

SWIFT AND SON'S POCKET MICROSCOPE.*

MESSRS. SWIFT AND SON have added a stand to their (Brown's) Pocket Microscope (Figs. 1 and 2), which is one of the smallest microscopes made having any pretensions to be a serviceable instrument, and not a mere toy. As now modified, it appears to be the most complete really "Pocket" microscope yet issued. It is furnished with 1in., ¼in., and ⅛in. dry objectives, and $\frac{1}{16}$in. immersion, three eye-pieces, achromatic condenser with rotating disc having three diaphragms, central stop, and radial slots, together with polariser, analyser, adjustable concave mirror in gimbal fitting; the whole (with glass slips), packing in a mahogany box 4¾in. by 3¾in. by 1¼in.

The standard consists of a conical pillar, to the lower end of which three rods are screwed radially, having milled heads at the outer ends, and forming a tripod foot; the upper end has a cradle-joint carrying a dovetail slide-socket, in which fits a corresponding slide at the back of the body-tube. The microscope can be inclined on the cradle-joint as required. The slides, which can be of the usual size, are held on the stage by a spring cylinder-clip, having two lateral projecting pins, which slide in right and left bayonet slots; the clip can be raised by the pins and keyed in the bayonet slots by a slight lateral turn when the slides are being put in or removed. The coarse adjustment is effected by sliding the body-tube; the fine adjustment by moving the draw-tube in or out—a plan which is far more convenient in practice than we should have anticipated. We have found no difficulty in focussing the ⅛th objective in this manner, either with the microscope on its tripod and the light reflected from the mirror, or by pointing the body-tube directly to the sky; and, doubtless, with a little practice, the $\frac{1}{16}$th could be used with the like facility. By the addition of adapters, the objectives could, of course, be used on full-size microscopes. The three high powers are provided with correction-adjustment. We understand that the microscope was constructed wholly by Mr. Mansel Swift. (Fig. 1, half-scale; Fig. 2, two-fifths scale.)

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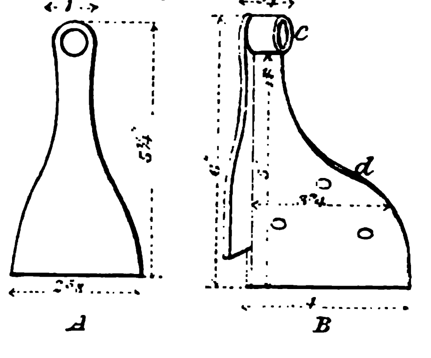
* Journal Royal Microscopical Society.

THE DYNAMO: HOW MADE AND HOW USED—X.*

By SELIMO R. BOTTONE.

§ 21. THE next pattern to be made is that of the *standard*, which supports the driving wheel. This should be made out of ¼in. stuff, a piece of which 5¼in. long by 2⅝in. wide must be cut to the shape shown at A, Fig. 17 (one quarter the real size). In order not to split the top while boring the hole, it is as well to bore the hole (which should be ½in. in diameter) before shaping the piece. For the same reason, the piece marked C, which should be ½in. thick and 1in. diameter when finished, should be glued to the centre of the top end of the piece A, and the whole bored (by means of a brace and sharp ½in. centre bit) before trimming up to shape. From the same ¼in. stuff, another piece, figured at B, is cut out, being ½in. wide at the top, sloping gradually, and becoming wider to about half its length (*d*) when it should sharply curve to a width of 4in. The length of this piece should be 5in., and it is to be glued and dowelled to the centre of the piece A, close against the boss C, as shown at B. A small piece *e* must now be glued and dowelled to the edge of the curved flange, so as to make it flush with the front A. When this has been smoothed and polished with paraffin, the patterns are ready for the foundry. The three holes shown at *d* may be bored in the castings.

Fig. 17



The Castings.

§ 22. The patterns may now be sent to the foundry, with the following instructions: First, the armature should be carefully annealed, so as to constitute a *malleable iron casting*; second, two legs should be cast from the pattern shown at Fig. 15, and these also must be carefully annealed, and be made as soft as possible; third, the standard (Fig. 17, B) will be better if left pretty hard, as in this way it will retain sufficient magnetism to start the machine without adventitious aid. Particular stress must be laid on the importance of the iron in the armature and legs being *very soft*, since much of the efficiency of the dynamo will depend on this point (see § 9). When the castings return from the foundry, their degree of hardness may be tested by trying with a rather coarse file. If the file bites easily, the iron is fairly soft; if it slips over without filing, it is altogether too hard. (This does not apply to the standard, which may be left quite hard without any detriment to the machine.) The armature must now be cleaned and trued up. If the student be the happy possessor of a lathe, this will not prove a difficult job; if otherwise, he may, by careful filing, remove any irregularities, and square up the ends. These must be made quite true; otherwise it will be impossible to centre the armature so as to rotate it between the poles of magnet. The thin central portion shown at *a*, Fig. 14, and there marked 2½, must have its edges rounded, so as not to cut the wire, which will have to be wound round it. No trouble should be spared to get the armature as truly cylindrical as possible; as care expended at this portion of the process will render the remainder of the work very much easier, and more satisfactory. The armature having been thus rendered true, the legs will demand our attention. Having gone over the surface with a bastard file to remove any irregularities, the curved channels, shown at A and B, Fig. 15, must be carefully cleaned out. Perhaps the quickest way to do this, and to clean the armature at the same time, is to lay the two pieces, channels uppermost, on a table, putting a little fine sand and water in the channels, and then to work the armature up and down the channels, first in one and then in the other, alternating also the sides of the armature, until the channels, as well as the external surfaces armature, are rendered quite smooth and bright. The sharp corners of the legs of the magnets around which the wire has to be coiled must also be rounded, and the top semicircular [illegible]

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Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Sh I	4	8	A.M.	10	II	Oc R	5	14	A.M.	22	I	Oc D	3	4	A.M.
1	II	Tr I	5	4	,,	10	*I*	*Sh E*	5	27	P.M.	22	I	Ec R	5	24	24 A.M.
1	II	Sh E	7	2	,,	10	*I*	*Tr E*	5	42	,,	22	IV	Tr I	11	8	P.M.
1	*II*	*Tr E*	7	59	,,	11	II	Sh I	8	0	,,	22	IV	Sh I	11	53	,,
1	*III*	*Sh I*	6	32	P.M.	11	II	Tr I	8	25	,,	22	I	Tr I	12	23	,,
1	I	Sh I	6	45	,,	11	II	Sh E	10	54	,,	22	I	Sh I	12	28	,,
1	I	Tr I	7	12	,,	11	II	Tr E		19	,,	23	I	Tr E	2	43	A.M.
1	III	Tr I	8	20	,,	13	I	Ec D	6	46	45 A.M.	23	I	Sh E	2	47	,,
1	I	Sh E	9	4	,,	13	II	Oc R	6	21	P.M.	23	IV	Tr E	3	38	,,
1	I	Tr E	9	32	,,	14	I	Sh I	4	5	A.M.	23	IV	Sh E	4	17	,,
1	III	Sh E	10	4	,,	14	I	Tr I	4	14	,,	23	III	Tr I	6	8	,,
1	III	Tr E	11	55	,,	14	I	Sh E	6	24	,,	23	III	Sh I	6	28	,,
2	I	Oc R	6	39	,,	14	I	Tr E	6	34	,,	23	I	Oc D	9	30	P.M.
2	II	Ec D	11	15	28,,	14	IV	Oc R	9	22	P.M.	23	I	Ec R	11	53	2,,
3	II	Oc R	2	59	A.M.	15	I	Ec D		15	13 A.M.	24	II	Oc D	6	48	A.M.
4	*II*	*Sh I*	5	25	P.M.	15	I	Oc R	3	40	,,	24	I	Tr I	6	49	P.M.
4	*II*	*Tr I*	6	11	,,	15	I	Sh I	10	33	P.M.	24	I	Sh I	6	56	,,
4	II	Sh E	8	19	,,	15	I	Tr I	10	39	,,	24	I	Tr E	9	9	,,
4	II	Tr E	9	6	,,	15	I	Sh E	12	53	,,	24	I	Sh E	9	16	,,
5	*I*	*Sh I*	7	42	A.M.	15	I	Tr E	12	59	,,	25	I	Ec R	6	21	35,,
5	*I*	*Tr I*	8	4	,,	16	III	Sh I	2	30	A.M.	25	II	Tr I	12	52	,,
6	I	Ec D	4	52	48,,	16	III	Tr I	2	53	,,	26	II	Sh I	1	10	A.M.
6	IV	Sh I	5	54	,,	16	III	Sh E	6	3	,,	26	II	Tr E	3	46	,,
6	*I*	*Oc R*	7	31	,,	16	III	Tr E	6	28	,,	26	II	Sh E	4	4	,,
7	I	Sh I	2	10	,,	16	I	Ec D	7	43	48 P.M.	26	III	Oc D	7	41	P.M.
7	I	Tr I	2	30	,,	16	I	Oc R	10	6	,,	26	III	Ec R	11	53	6,,
7	I	Sh E	4	30	,,	17	II	Ec D	4	27	30 A.M.	27	II	Oc D	7	55	,,
7	I	Tr E	4	50	,,	17	*II*	*Oc R*	7	28	,,	27	II	Ec R	11	10	33,,
7	I	Ec D		21	14 P.M.	17	*I*	*Sh I*	5	2	P.M.	29	I	Oc D	4	48	A.M.
8	I	Oc R		57	A.M.	17	*I*	*Tr I*	5	5	,,	29	*I*	*Ec R*	7	18	47,,
8	II	Sh I	6	43	,,	17	I	Sh E	7	22	,,	29	*II*	*Tr E*	4	53	P.M.
8	*II*	*Tr I*	7	18	,,	17	I	Tr E	7	25	,,	29	*II*	*Sh E*	5	22	,,
8	I	Sh I	8	39	P.M.	18	*I*	*Oc R*	4	32	,,	30	I	Tr I	2	7	A.M.
8	I	Tr I	8	56	,,	18	II	Sh I	10	35	,,	30	I	Sh I	2	22	
8	III	Sh I	10	31	,,	18	II	Tr I	10	38	,,	30	I	Tr E	4	27	,,
8	I	Sh E	10	59	,,	19	II	Sh E	1	29	A.M.	30	I	Sh E	4	42	,,
8	I	Tr E	11	16	,,	19	II	Tr E	1	33	,,	30	I	Oc D	11	14	P.M.
8	III	Tr I	11	37	,,	19	*III*	*Oc D*	4	26	P.M.	31	I	Ec R	1	47	28 A.M.
9	III	Sh E	2	3	A.M.	19	III	Oc R	8	1	,,	31	*IV*	*Oc D*	6	55	,,
9	III	Tr E	3	12	,,	20	II	Oc D	5	41	,,	31	I	Tr I	8	33	P.M.
9	*I*	*Ec D*	5	49	46 P.M.	20	II	Oc R	8	35	,,	31	I	Sh I	8	51	,,
9	I	Oc R	8	23	,,	21	I	Tr I	5	57	A.M.	31	I	Tr E	10	53	,,
10	II	Ec D	1	51	30 A.M.	21	I	Sh I	5	59	,,	31	I	Sh E	11	11	,,

Ec Eclipse; **Oc** Occultation; **Tr** Transit of Satellite; **Sh** Transit of Shadow; **D** Disappearance; **R** Reappearance; **I** Ingress; **E** Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

is about as favourably placed for the observer as he well can be. His great angular diameter (42·6″ on January 1st, increasing by the 17th to 43″) renders him an easy object, even in the most moderate telescope.

The retrograde path thus indicated lies wholly in that void region of Cancer to the West of the Præsepe and the cluster of principal stars in that Constellation.

Saturn

Is visible during all the working hours of the night, and continues to present an all-repaying spectacle to the observer. He is now slowly receding, though, from the Earth, and his diameter diminishes from 18″ on January 1st to 17·2″ by the end of the month.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	4	10·3	19	5·9	9	26·5 p.m.
6	4	9·1	19	4·1	9	5·7 ,,
11	4	8·2	19	2·7	8	45·1 ,,
16	4	7·4	19	1·9	8	24·7 ,,
21	4	6·8	19	1·5	8	4·4 ,,
26	4	6·4	19	1·7	7	44·3 ,,
31	4	6·1	19	2·4	7	24·4 ,,

Hence it will be seen that Saturn starts from a point about 3° to the west of ε Tauri, and describes a short retrograde arc in the Constellation to which that star belongs.

Venus

Is an Evening Star during the whole of January, and may be discerned with the naked eye close to the horizon immediately after sunset, on clear *evenings, towards the end of the Month. At the beginning of it she is but poorly placed,* indeed, for the observer. Her angular diameter increases very slowly from 11·2″ on January 1st to 12·4″ by the 31st. She is perceptibly gibbous in the telescope.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	20	34·5	20	26·2	1	51·9 p.m.
6	21	0·0	18	48·6	1	57·7 ,,
11	21	24·9	16	57·9	2	2·9 ,,
16	21	49·2	14	55·7	2	7·5 ,,
21	22	13·1	12	43·5	2	11·6 ,,
26	22	36·4	10	23·1	2	15·2 ,,
31	22	59·2	7	56·0	2	18·4 ,,

Hence it will seen that Venus will start from Capricornus, across which constellation she will travel until the 16th, when she will enter Aquarius. She will not have entirely crossed Aquarius by the 31st. She will be rather more than 1° South of the 4th mag. Star λ Aquarii on the 28th.

Ceres,

Shining as a 7—8th mag. Star, is practically visible all night long. An ephemeris for intervals of 10 days will suffice for the comparatively small number of observers who will care to scrutinise such an object.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	4	31·9	21	51·3	9	48·1 p.m.
11	4	26·3	22	16·1	9	3·2 ,,
21	4	23·6	22	43·5	8	21·2 ,,
31	4	23·9	23	13·9	7	42·2 ,,

From which it will be seen that Ceres is in Taurus, to the North of the Hyades, in a part of the sky destitute of stars visible to the naked eye.

Juno

Comes into Opposition to the Sun on January 4th, shining as a reddish 8th mag. Star, and may be seen during the chief working hours of the night.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	6	55·0	0	40·6	12	10·7 p.m.
11	6	46·2	1	41·5	11	22·7 ,,
21	6	38·9	3	4·7	10	36·1 ,,
31	6	34·0	4	41·6	9	51·9 ,,

Juno thus travels backwards in the Constellation Monoceros, across part of the Milky Way.

Uranus

Is only above the horizon during the morning hours, so that we shall defer our Ephemeris of him until next month; but

Neptune

Is still visible during the working part of the night. As we have, however, said, upon more than one occasion, he shines only as a 7—8th mag. Star, and is singularly destitute of interest as a telescopic object: only the largest instruments being competent to raise a perceptible disc on him.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	3	6·2	15	36·8	8	22·6 p.m.
6	3	5·9	15	36·0	8	2·6 ,,
11	3	5·7	15	35·4	7	42·7 ,,
16	3	5·5	15	35·0	7	22·9 ,,
21	3	5·4	15	34·8	7	3·1 ,,
26	3	5·3	15	34·9	6	43·4 ,,
31	3	5·3	15	35·2	6	23·7 ,,

This short path lies in that very barren region in the Eastern part of Aries.

Shooting Stars

May be especially looked out for on the Nights from the 1st to the 3rd, and again on those included between the 15th and the 19th.

Greenwich Mean Time of Southing of Eighteen of the Principal Fixed Stars on the Night of January 1st, 1884.

Star.	Souths. h.	m.	s.	
α Andromedæ	5	19	18·24	p.m.
α Cassiopeiæ	5	50	46·03	,,
β Ceti	5	54	34·57	,,
Polaris	6	33	51·54	,,
α Arietis	7	17	14·10	,,
α Ceti	8	12	39·88	,,
α Persei	8	32	27·53	,,
γ′ Eridani	9	8	54·85	,,
Aldebaran	9	45	28·10	,,
Capella	10	24	13·90	,,
Rigel	10	25	3·39	,,
α Leporis	10	43	39·42	,,
α Orionis	11	4	52·72	,,
γ Geminorum	11·46		53·02	,,
Sirius	11	55	52·95	,,
Castor	12	42	55·19	,,
Procyon	12	48	56·40	,,
Pollux	12	53	54·42	,,

Were the Stars absolutely and rigidly "fixed," any given one would South 3m. 55·91s. (or 235·91 seconds) sooner every day. This is so very approximately true with a large proportion of them, that we may assume it to be accurately so; and to find the time of the Meridian Passage at Greenwich of either of the Stars in the above List for any other night in January we have only to multiply 235·91 seconds by the number of days which have elapsed since the beginning the month (*i.e.*, by the day of the month − 1), and subtract the result from the time given in our table. For example: At what hour will Sirius South at Greenwich on the night of January 11th? Here 11 − 1 = 10, and 235·91 × 10 = 2359·10s., or 39m. 19·10s. If, then, from 11h. 55m. 52·95s. we take 39m. 19·10s. we shall obtain 11h. 16m. 33·8 as the Greenwich Mean Time of Southing of Sirius on January 11th. This really errs ·05s. from the actual instant of Transit—a quantity which no mean-time clock is able to indicate. In the case of Polaris, or any tolerably close circumpolar star, the error would be slightly greater; although even in that case abundantly sufficient accuracy would be attained for obtain- Mean Time from the Star's transit.

We may, however, further wish to ascertain the Local Mean Time of Transit of one of the above stars, and this we may do by subtracting 9·8565s. from the time given in our table for every hour of Longitude (and proportional parts for minutes and seconds when our Station is to the West of Greenwich, and adding that quantity when our Longitude is East). Thus: At what time will Capella South at Penzance on the night of January 1st? Penzance is 22m. 12s. West of Greenwich; so we say 60m. : 22·2m. : : 9·8565 : what we shall find to be 3·65s. Penzance being West of Greenwich, we must, according to the precept, subtract this from the given time, and say 10h. 24m. 13·90s. – 3·65s. = 10h. 24m. 10·25s.,—the instant a clock set to Penzance Mean Time should mark when Capella is on the Meridian of that place.

PRACTICAL NOTES ON PLUMBING.—LXXXVIII.—LXXXIX.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from p.* 335.)

Gutters with Springing.

THIS kind of gutter is shown at diagram 411, and is simply a piece of feathered edge stuff nailed on, as shown at S F, an enlarged view of which is shown at diagram 422. The use of this is to tilt the bottom course of slates, and is generally about 2½in. to 3½in. wide and ⅜in. thick at the thickest part, feathered off to nothing. It should be nailed about 4in. from the bottom of the gutter, and carried straight past the drip, then sloped down to meet the springing for the gutter below. The angles should be properly mitred, and left quite smooth and even.

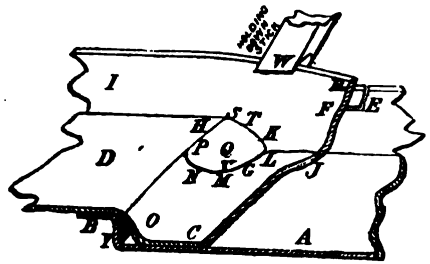

Fig. 421.

When such gutters are to be put in, take the bevel of the roof from D to E, diagram 411, and work your lead to this angle, which of course is not half the work as a square corner. Having worked the lead to the shape, put the gutter into its place. Now take a piece of quartering, and place it on the side of the lead and the bottom of the springing, as from Q to S; then kneel upon it, and break it into the springing, which is done by pulling the lead square up against the quartering, and pushing it back fair over the springing. After this is done with the hard (boxwood) dresser, dress the lead well into the bottom of the springing, and middling sharp over the arris. If the springing is properly nailed on, this will hold the lead down.

Sometimes it happens that the gutter has to be made with a square side, and the springing nailed on at the edge, as at S T, diagram 422. When such is the case, the end of the gutter is worked up square, and then on the splay, as at F E. I may here remark that in nearly all cases, when slating over the ends of curves and sides of lead gutters eaves, that springing, as illustrated at diagram, is required for tilting the bottom course of slates: and this should always be looked after by the plumber, because as a rule he is always on the job *before the slater, who cannot make good work unless* the springing is fixed. Speaking of springing, I may say that it should always be fixed under the slates by the side of walls where stop flashings are used (of course the thick part C goes against the wall), as this throws the slates towards the middle of the roof, and the water out from the wall, and so keeps the walls dry; but when soakers are used, then such springing is not required.

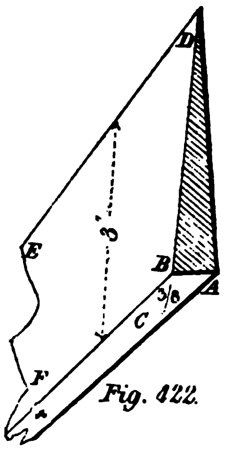

Fig. 422.

Secret Gutters.

These are illustrated at diagram 424. It is simply a gutter formed up the roof by the side of the wall, as at A B, and diagram 424. The general plan is to make them about 2½in. wide, and in such a manner that a welt may be formed on the lead as at F, diagram 424. This prevents water from running back under the slates; but care must be taken that the under lead of the gutter is not too wide, otherwise the slater will drive his nails through the lead, and here will be a chance of leakage. Of course the secret gutter slates should go up to the wall; but in this diagram they are kept back to show the lead. I have laid secret gutters exactly as shown in this diagram; but such gutters were 12in. wide, and, therefore, could hardly be called secret gutters. The gutters referred to were made for the sweeps to walk up when their attention was required to the chimneys.

Breaks.

For this, turn back to diagram 415. Here is a break suitable for a square 12in. ventilating or air shaft. On examining this it will be found to be useless to attempt to work up the sides, simply because you have not sufficient stuff to do so. For example, from X to Y, diagram 415, is 6in., and also from 1 to 2. From 1 to Y is 12in., so that the two sides alone will take all the stuff, leaving nothing for the ends. When such is the case, or anything approaching such, do not attempt to work it, but cut the two sides or two ends and solder a piece in and up the angle. But suppose your break to be, say, 3ft. long by, say, 14in. wide, or something of this sort, as illustrated at M V, &c., diagram 422. Here you have plenty of stuff, and to spare. For the marking out, turn to diagrams 407 and 408. Suppose that you have lined out the side B A, and the end R Q (Fig. 408), also the side C D.

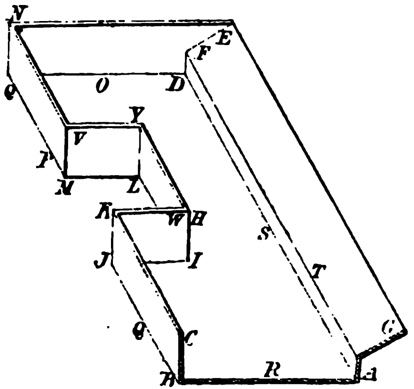

Fig. 423.

Next measure your distance from the end of the gutter at Q, to the corner I J of the break, and strike the line I J. Next measure the length of the break, as at K L, and strike this line, but allow room for the gutter to go in easily. The leadwork of the break or opening should be ¼in. larger than the break. Next measure the width of the break as from R to E and L to F (Fig. 407), or as from M to L, and J to I (Fig. 423), and set these lines out upon the lead, as at O P L M (Fig. 408), but see that they are put to the same angle on the lead as they are in the work.

Here are the lines of your break. Now measure the stand-up lines as at P O, M N, and H G, diagram 408, and shape the line in the lead as shown. Then chalk *outward* from these lines the corner lines, S J and T L, as shown by the dotted lines. Be sure and mark them rounded, as though with the compasses struck from the intersecting line at E I and K F, so that you may have enough stuff to drive back into the corners, so that the corner may be its proper thickness. A good plumber will work a lot of the stuff from the corners into the break, that is if the break is not too wide. Having marked it out as shown, now cut the piece out as indicated by the dotted lines J S T L, then pull up the back or side R A and the end C B, and work these two corners up; that is A and B diagram 407. Having these corners worked up, now pull up the sides of the break; but in doing so do not strain the lead at any point. Now take a sharpish box dresser, and well mark all round the lines L K, F E, and I J. I generally do this with a sharp chace wedge. The principal object of this is to get a line, as the chalk line is apt to get rubbed out. Having this done, and the sides pulled up as far as it will allow, turn the gutter on its side as at diagram 416, and put in a stiffener all round the edges of the break. Now (see that it does not tumble over) get your dummy and bossing stick and work away at the corner L Z, at the same time driving your extra lead into the break angle and towards the point K F or E I. Keep working away very evenly, keeping your corners nice and round, and by degrees the corner and break [illegible] the sides. When done, [illegible]

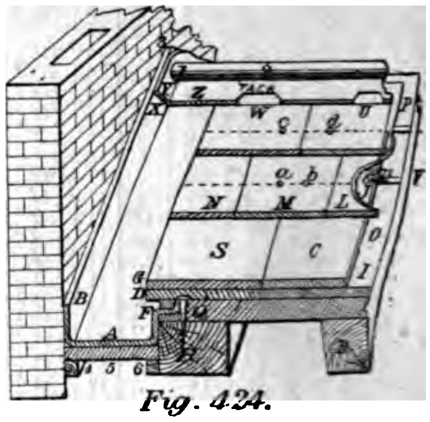

Fig. 424.

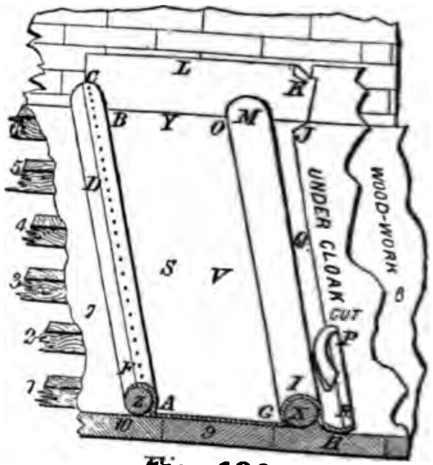

Fig. 426.

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* *From the Building News. All rights reserved.*

[illegible] When [illegible] taken as unity, we get the following [illegible]:

Objective focus, F = 1·000
Aperture, A = ·066
Focus of each corrector, f = ·074
Aperture, a = ·022

A[illegible] case the ratio of apertures may be taken as 4 to 1: we should then have—

Objective focus, F = 1·000
Aperture, A = ·066
Focus of each corrector, f = ·041
Aperture, a = ·016

With the use of correctors of very short focus, their difference in focal length with the same curves is considerable. Thus in the second of the above combinations, the focus of an equi-concave flint would be about ·036, giving a difference of ·005 or $\frac{1}{200}$ of the whole focal length. It is also very desirable that the correctors should be cemented; but this seems scarcely possible when minute differences of aberration have to be compensated. Probably the triplet form has some advantages for a short-focus corrector.

The problem of correcting a single lens by a smaller combination at some distance from it seems to have formed the subject of some correspondence between Sir John Herschel and Mr. Rogers, as the letter from which I have quoted concludes thus: "This construction appears shorter than Mr. Barlow's with an account of which you favoured me, there being no extension of the original focus of the object glass; but where a high magnifying power is required, this extension of the focus and focal power is certainly a great advantage, and might be easily adopted in this construction by allowing the interposed lens to act as a concave in the manner you suggest. And if such an alteration destroys or materially reduces the secondary spectrum, it must be an immense improvement of the construction I have described; for in it the magnitude of this spectrum appears to be the same as in the ordinary achromatic. At all events, I hope that the reduction of the size of the flint lens and the facilities of destroying the aberrations will prove conducive to the practical perfection of the telescope."

There is a wide field for experiment with this method of obtaining achromatism. It does not seem likely that it ever can equal or surpass the ordinary plan because the coloured rays must become considerably separated by the time they reach the correctors, and it is difficult to see how they can be entirely reunited. But no purely theoretical deductions can be safely relied on in matters of this kind, for the compensatory influence of many rays in their passage through several lenses may give rise to results which it would be difficult to account for. The different practical accounts which have been related, and in which various arrangements of lenses have been used, seem to show that as regards central rays the dialyte is not inferior to the ordinary achromatic. Whether anything can be gained in reduction of the secondary spectrum, by permitting the negative refraction to lengthen the original focus, seems doubtful. But setting aside minute matters, it is well to remember that it is not every observer who needs a telescope of the highest excellence. The question is not so much whether the dialyte can be made equal to the ordinary achromatic, as to whether it will furnish a good and useful instrument. The practical accounts which have been given by Messrs. Rogers, Wray, [illegible], and Smith, are sufficient to show that with patience and perseverance and care in its adjustment and use, the dialyte will form a very efficient substitute for the ordinary achromatic telescope.

ALUMINIUM AND ALUMINIUM ALLOYS.

Not much has been heard lately of the new [illegible] of obtaining aluminium which [illegible] commercial world [illegible] the raw material [illegible] the metal would be as useful [illegible] at a low price, that it [illegible] to be taken [illegible] to render the [illegible] One of [illegible] is a method of obtaining [illegible] alumina from alum, patented by W. H. Thompson, [illegible] In the [illegible] the patentee takes a given quantity of aluminium sulphate or ammonium alum, potash alum, sodium alum, or other salts or compounds of alum, and dissolves it in a sufficient quantity of water to form a concentrated solution. To this he adds an excess of alkali; by this means all the alumina contained in the solution is precipitated as a gelatinous hydrated precipitate of alumina mingled with impurities. This precipate should be collected on a filter, and drained and dried. It is then subjected to a red heat, or any higher heat, long enough to reduce it to a calcined oxide. The calcined oxide is then washed with water, which will within a very short time, in comparison with the old process, remove enough of the impurities to leave the alumina sufficiently pure to be manufactured into aluminium by the present well-known processes. The patentee, however, recommends that ammonium alum, or aluminium sulphate be used, and the following process employed. In producing the gelatinous hydrated precipitate from ammonium alum, or from aluminium sulphate, use as an alkali ammonia, either in the form of concentrated liquor ammoniæ or by passing ammonia gas through the solution. The precipitate is reduced to a calcined oxide, so as to drive off the sulphate of ammonia, which will generally require from fifteen minutes to half an hour. The calcined oxide thus produced from ammonium alum or from aluminium sulphate is alumina sufficiently pure to be manufactured into aluminium by the present well-known processes. The process of obtaining aluminium patented last year by J. Morris, of Uddington, consists in mixing a solution of aluminium chloride with powdered wood charcoal and lampblack, then evaporating until it forms a viscous mass, which is shaped into balls. During the evaporation, hydrochloric acid is given off. The residue consists of alumina intimately mixed with charcoal. The balls are dried, then treated with steam in appropriate vessels for the purpose of driving off all the chlorine, care being taken to keep the temperature so high that the steam is not condensed. Then the temperature is raised, so that in the dark the tubes are seen to be at low red, and dry carbon dioxide is passed through. This is said to be reduced by the charcoal to carbon monoxide, which then reduces the alumina to aluminium. Although the quantity of the escaping carbon monoxide is in general a good indication of the progress of the reduction, it is nevertheless advisable not to continue the heating of the tubes or vessels until the evolution of this gas has ceased or even nearly ceased, as, in consequence of slight differences in the consistence of the balls, some of them give up all their carbon sooner than the others. The treatment of the balls with carbon dioxide for the purpose of the reduction lasts about 30 hours, when the substances are mixed in the proportions of 5 parts carbon to 4 parts alumina. As Morris states, the metal appears as a porous, spongy mass. It is freed from the residual alumina and particles of charcoal by fusion and mechanical treatment, and is then poured into moulds.

AN EASY METHOD OF PRODUCING NEGATIVES FROM PRINTS.*

HAVING had a little leisure time on my hands during the last few days, I thought that I could amuse myself by making some enlargements from very small negatives.

The first method tried was that of magnifying an enlarged transparency from the small negative, and then making from the transparency a paper negative, which was waxed. This method, I believe, was introduced by Mr. Valentine Blanchard.

However, I was not satisfied with the result obtained, as I could not entirely prevent the grain of the paper showing in the finished proof. I next tried the ordinary method of making a small transparency and enlarging from that; but the result did not satisfy me. Finally I hit on an idea which I believe to be novel, and which is the object of this communication.

I first of all take a print from the small negative on albumenised paper, in the ordinary way, which is toned and fixed as usual. I then mount this print on glass, face downwards, with gelatine. This mounted print is then placed in front of the copying or enlarging camera, and an enlarged negative is taken from it. Owing to the print being in such close contact with the glass, the enlarged negative does not show the grain of the paper, and I find this way of enlarging to be by far the most satisfactory of any I have tried.

At present, I have only made a few enlargements in this manner, and I have sent two negatives, [illegible] the prints from which they were made, for your in[illegible]spection, as from this experiment I think it a ve[illegible] satisfactory way of enlarging.

One thing I have already discovered, and that [illegible] that it is necessary to avoid, as far as possi[illegible] having air-bells intervening between the print an[illegible] glass; for if they come on the sky of the mou[illegible] print, they will show on the enlarged negative.

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* By C. E. ABNEY, a paper read before the London and Provincial Photographic Association.

NEW DEVICE IN PHOTOMETRY.

A NEW method of measuring the intensity [illegible] very powerful lights is described in [illegible] *Zeitschrift für Instrumentenkunde.* If any stro[illegible] light, like the electric light, for example, is to b[illegible] compared with a normal candle, the distance [illegible] which the former must be removed is inconveniently great. Dr. H. Hammerl has devised a very ingenious method of reducing the intensity of any light by purely mechanical means, cutting of one-half, three-fourths, or even nineteen-twentieths of the light, so that what remains is easily measured. It consists in placing in the path of the rays that fall upon the screen a revolving metallic disc from which are cut sectors that allow a portion of the light to pass through, but cut off and absorb the remainder. If the sum of the angles of all the sectors taken together equal 180 degrees, one-half of the light will be intercepted while the other half passes through. Experiments show that three sectors will suffice to give a uniform illumination with a moderate speed of [revolution. The size of these sectors will, of course, depend upon the amount of light to be cut off. When it is desired to reduce the light to one-third, each sector must has an angle of 40°. If each sector have an angle of 12°, the light will be reduced to one-tenth, and so on.

When two discs are employed, each having three sectors of 60° degrees each, they can be so arranged on the axis as to give any desired result.

If a single disc is employed, the openings should not be true sectors, having a definite angle at the centre, but cut so that the angle increases from the centre towards the circumference in a definite ratio. This may be so chosen that the weakening shall regularly increase from centre to circumference just as the distance from the centre increases. When this form of disc is employed, the usual greased spot on the screen must be elongated instead of round, and as long as this opening. One end of this spot will be dark, the other light, and it must be noticed where this change occurs, and the amount of weakening read by a scale on the disc itself.

THE E.M.F. AND RESISTANCE OF BUNSEN CELLS.

AT a time when the work and constancy of battery cells are subjects of dispute and interested advertisement, any details of carefully conducted experiments are of considerable value. We therefore abstract the chief points of a short paper contributed by Mr. G. G. Grower to *Van Nostrand's Engineering Magazine.* The electromotive force of cells, as given in various books, seems very irregular; different figures being given by different authorities. This may be partly due to the fact that the electromotive force is constantly changing while the cell is working, being highest at first, and falling more or less rapidly according to the work the cell is doing. The density of the acids or solutions used also affects the electromotive force, and as experimenters use different densities, this may also account for part of the irregularities mentioned. The resistance of the cells keeps changing also, and very few books give any figures in regard to it. The electromotive force of cells is usually given in volts, and although the volt has an absolute value theoretically, it is practically a very uncertain unit.

The Daniell cell, charged with solution of zinc sulphate, is frequently used as a standard of electromotive force; it is taken as 1·079 volt by many experimenters, but some regard it as ·955 volt, and still others as one volt. This shows how uncertain the volt is as a practical unit of electromotive force. The Bunsen cell is charged in a number of different ways, each of which has it advantages and disadvantages. The two commonest ways of charging is to fill the porous cup with nitric acid, or a solution of bichromate of potash in sulphuric acid. The zinc is put in dilute sulphuric acid.

To compare the merits of the two ways, one cell was set up charged each way, and they were left to run down on a resistance of about 1 ohm. The electomotive force, resistance, and current were taken at intervals. The method of obtaining the electromotive force, etc., was as follows:—

The cells were left short-circuited on a resistance of 1·05 ohm, except when deflections were taken. A key was inserted in line, which kept the circuit closed, except when depressed, when it threw the cell direct on the galvanometer. By [illegible] switch the galvanometer could be connected to the terminals of 1 ohm in the line. The galvanometer used was a high-resistance reflector shunted so that a suitable portion of the current would go through it. A high resistance was also inserted in the galvanometer line. The steady deflections are proportional to the current; but as it takes time to bring the spot to rest, the battery may have changed considerably when the deflection is obtained. The electromotive of the cells begins to increase the moment the current is stopped. The various swings or impulses are also proportional to the current, so to make the observations rapidly, before changes can occur in the cell, the first swings were taken.

For a standard cell I used a Daniell containing a saturated solution of copper-sulphate and a solution of zinc sulphate, prepared by dissolving 1 part of zinc sulphate in 10 of water. Pure chemicals were used in this cell. The zinc was not amalgamated. The galvanometer was set so that the standard cell gave a first swing of 100, therefere each deflection meant ·01 of the standard cell.

It will be seen from the above that the deflection of the cell equals the electromotive force, that of the ohm equals the current. The electromotive force divided by the current equals the total resistance; subtracting from this the external resistance 1·05, we have left the resistance of the cell in ohms. The dimensions of the cells were: glass jar, 4in. diameter, 5in. high; porous cups, 2in. diameter, and zincs, 2½in. diameter. The carbons were about ¾in. by ½in.

Each jar contained 25 cubic inches of dilute sulphuric acid (1 to 12 by volume). No. 1 contained 6 cubic inches of nitric acid (spr. gr. 1·35) in the porous cup; No. 2, 6 cubic inches of chromic solution, prepared by dissolving nearly 1oz. of bichromate of potash in 15 cubic inches of water, and then adding 3 cubic inches of sulphuric acid. The zincs were amalgamated the day before using; they were also weighed, so that the amount of local action could be ascertained. The cells were left charged 1½ hour before using. External resistance was 1·05 ohm.

The electromotive force is given in terms of the Daniell cell; the resistance in ohms. The current answers the formula $\frac{E}{R}$

After working 5 minutes the E. M. F. with the nitric acid cell was 1·70, the current 1·20, and the resistance ·35; with the chromic solution the E. M. F. was 1·40, current ·90, resistance ·50. At the expiration of one hour, the nitric acid cell gave E. M. F. 1·69; C. 1·23, R ·32; the chromic cell, E. M. F. 1·17; C. ·79; R. ·43. At the end of five hours the nitric acid cell gave E. M. F. 1·65; C. 1·23, R. ·28; the chromic E. M. F. ·76; C. ·49, R. ·50. At the end of 25 hours the nitric acid had still E. M. F. 1·02; C. ·63, R ·56: but the chromic cell had only E. M. F. ·31; C. ·17, R. ·77. The current here taken will dissolve in 1 hour 1·32 grain of zinc.

Zinc wasted in nitric acid cell is about 30 per cent. as much as utilised.

Zinc wasted in chromic cell is about 19 per cent. as much as utilised.

The figures show that although the electromotive force of the cell with the chromic solution is at first higher than with nitric acid, it immediately falls far below it.

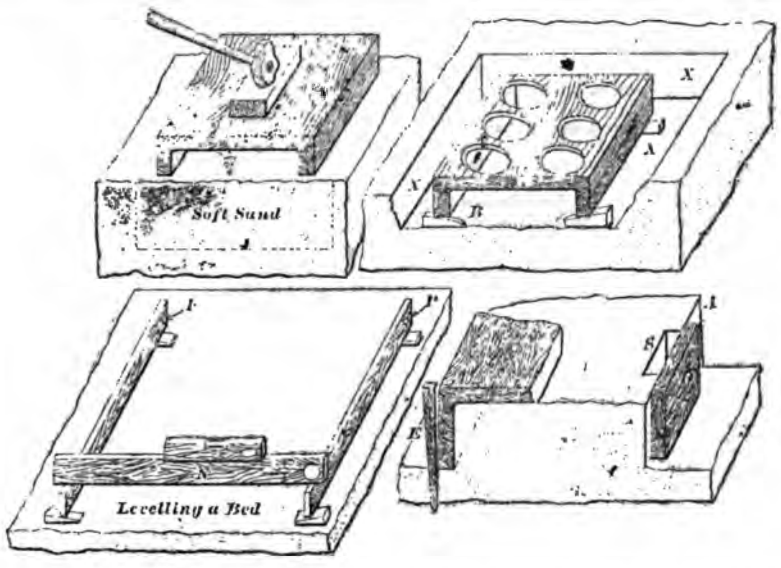
The nitric acid cell holds its electromotive force well until nearly exhausted. With nitric acid the resistance is less and the current stronger and steadier than with chromic solution.

The nitric acid cell is far superior to the chromic as far as the work is concerned, and if it were not for the disagreeable and unhealthy fumes it gives off, would be used in nearly every case.

BEDDING IN AND ROLLING OVER.*

BEDDING in and rolling over patterns in moulding have each their special advantage. As a general thing, rolled over moulds produce the smoothest castings, and are the simplest to construct, the reverse being the case with bedded-in castings. A moulder that cannot successfully turn out a good general run of casting by rolling over never need attempt it by bedding in. The writer is well aware that there are castings that cannot be as reliably made by rolling over as by bedding in, but this fact does not change the truth of the statement made. It will be acknowledged by all practical moulders who have had experience in both rolling over and bedding in, that to do general bedding in requires higher skill than rolling over. Any shop that does most of its moulding by rolling over can get along with less skilled mechanics than where the patterns, as a general thing, are bedded in.

When a moulder is furnished with nice patterns and flasks, the requirements are like those of machine labour; the physical and not the mental powers are the ones most required. Were there more bedding in practised, we would have more and better-skilled tradesmen. A novice, in travelling through the foundries of the country, would be at a loss to reason why shops, in making similar castings, do not adopt similar methods. He sees one bedding in almost everything. Another he finds rolling over everything. In many cases this puzzles even practical men to reasonably explain. One can go into many shops and there see patterns being bedded in that, all points considered, could be better rolled over. Then, again he will find the reverse, there being large expensive flasks used for moulds that could be made in less time, and with far less risk by being bedded in. There is no doubt that upon this point there are shops that are working in error. Almost every machinery foundry has some jobs that would be better were they bedded in, and some that would be better rolled over.



Sometimes circumstances may be such as to call for a pattern being bedded in, when properly it should be rolled over. This, however, is no excuse for the wide difference in shop practice.

I have seen practical men who, when questioned why they did not have certain jobs bedded in, would say they knew it was the proper way to mould them; but having so little of that class of work to do they, did not like to have their shop floors all dug up. This is, no doubt, in many cases a good reason for not bedding-in work. Shops in which most of the work is bedded in are, as a class, the dirtiest and ugliest to be found. It is pratically impossible to keep them as clean and orderly as a shop that does all rolling over. A foreman that loves order hates to see his shop a jumble of holes, sand heaps, and foundry tools. He may to some extent control and keep order, but to this there is a limit. It can be carried so far as to be a source of expense, rather than of profit. My lot has been chiefly to be employed with the dirty class of shops. It has often made me feel envious of my brother tradesmen who work in the clean shops, to think with what comfort they can work; and I would long ago have been one of their number were it not for the charm that bedded in and heavy work has for me. There is a fascination about bedding in that many moulders enjoy, whether because it is so dirty or that it makes them exercise their brains more, is for them to say.

The advantage that bedding in has over rolling over, is, in the first place, the saving of flask making; second, the rigidness with which sides and bottoms of moulds can be supported against the strains of high and heavy heads of metal: third, the assurance it presents of making a casting the duplicate of the pattern in shape. The twisting and wrenching that is given large flasks in being turned over often makes it impossible to make a casting as true as its pattern.

It is amusing to see how some moulders who have never done bedding-in go about such jobs. Not very long ago a moulder who thought himself a first-class man started to work under my supervision. I gave him a pattern, with instructions to bed it in. He said if he had a flask to roll it over he could make it in half the time. My answer was, that we did not make a practice of making expensive flasks that could be saved by bedding in; especially so where there was only one or two of a piece to make. He started at the job, and at the end of about two hours he put on his coat, remarking to a moulder, that he was not going to work in a shop where they had to lay upon their bellies to make a mould. The trouble was, he did not know how to bed in, and would willingly have kept that position all day if it would have given him the knowledge which his conceit prevented others from giving him.

Among moulders who bed in, there are two plans that are often adopted. One is to pound down a pattern, and the other to tuck it up. This pounding down business I do not approve of. In the first place, it causes a mould to be the reverse of what its condition should be (a point which I have previously written upon); in the second place it abuses a pattern, and in the third place, although it may often be a quick process, it is not by any means a mechanical one.

Any bull head can sledge down, but it requires skill to tuck up.

There are a large number of patterns that can be either sledged down or tucked up; the one shown in the sketch being of that class. In sledging down such patterns, the process is generally to first dig out a hole and fill it up with sand riddled through the shovel, then sift on about ½in. thickness of facing sand on top of which set the pattern, and on top of this the block, without any regard to which way the grain of pattern timber runs.

Then sledge down the pattern until about level with the sand bed, that is providing the patterns hold together.

To tuck up such a pattern, the hole is generally dug out about 3in. deeper than the pattern, and the pattern is rested upon four blocks or wedges, as at B; or, the four bearings may be sand mounds; with the hand sand is tucked under the pattern, after which the pattern is drawn and the surface of the mould felt all over, and any soft spots found filled up. A thickness of about ¼in. facing sand is then sifted on the bed, and the pattern returned. A sledge is then used to knock it down about ¼in., after which the sides X X, are rammed up, the joint scraped off and the pattern sighted to see if it is out of wind. This completes the bedding in.

While this in substance is one proper way to bed in, I will dwell upon a few details showing different ways of handling such jobs. Some, in tucking up such jobs, especially if the boss is not looking, will use all facing sand for the inside. Others will use all common heap sand, and when the pattern is drawn they will press facing sand against the sides; and after sifting ½in. thickness, or such a matter, over the surface, the pattern is knocked down to its bed. Some, again, will draw the pattern up to examine if all places are firm and of an even hardness. There is a great difference in the ability of moulders to make a firm bed the first time. Some will have to draw out a pattern three or four times before they can get as firm and reliable tuck as others can obtain by once drawing out.

Before going any further there are two points which I would call especial attention to. The first is the rapping down of tucked up patterns. Before a pattern is first drawn the guiding stakes should be driven so as to be a guide in showing how much the pattern is to be knocked down. At E, the stake is shown driven, having its top even with the top of pattern, there being one of these stakes at each corner. When the pattern is returned it is readily shown how much it should be pounded down. I doubt if one-fourth of the moulders ever make any calculation upon knocking down a pattern. Some of them pound until the pattern will go no farther, and others won't impress it enough. Every piece that is bedded in should have a limit to its impression into the bed, and the moulder should use his judgment as to what that limit is. The majority of moulders can tell by feeling a mould whether it is too hard or too soft. This is certainly an accomplishment, but it would be a better one to know how and when they were making it hard or soft. The second point I would like to call up is shown at D. This represents a plan which some moulders have of filling the sides of tucked up mould is a very good plan too. It is simply cutting out a piece of the side of the mould, and then by means of a board, D, running up the cut-out place at S with facing sand. After this cut out another portion and ram it up, and so on until the whole side is rammed up. This plan for heavy work, where sides or flanges cannot be come at to ram solidly up with facing while the pattern is in place, is a good one to adopt, as it gives a chance to make a firm surface when the pattern is withdrawn. There are many patterns where level beds can be used to assist in bedding in, the plain surfaces of the patterns resting upon the beds, and the irregular parts being tucked up. Wherever a levelled bed can be used, it should be, as there is no way that a mould bottom can be controlled and made so reliable.

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* By Thos. D. West in *American Machinist*.

Few moulders will make a level bed. In levelling a bed, one side, as F, should be first leveled up, after which set the opposite one, P. Then upon the top of each and at one end, as seen, set a parallel straightedge (by parallel I mean that it must be [illegible] the same width at each end, not 1in. at one end and ½in. at the other). The straight edges F and P do not require to be parallel, but N must be if a level bed is wanted. With the parallel straightedge, level across from F to P, then try the level on P; and if it should not be level, make it so by raising or lowering the end at P. Then test the straight edges by going over them all two or three times if necessary. Another point to be watched is the level, which in a foundry soon gets out of truth. The way to test a level is to turn it end for end. If it shows level one way and not another, it is out of truth. The only way to use such a level is to turn it end for end, and make the bulb stand the same distance from the centre mark each way.

Under the straightedges shown are four wedges, representing what should be sand mounds. The middle portion of the straight edges should be kept clear until they are levelled up, after which tuck under them. Levelling straightedges having a bearing their entire length causes a loss of time and extra labour. The holes seen in the straight edges are to hang them up by—something that is not always done.

The six holes seen in the pattern being bedded in, show a provision that ought to be allowed in many patterns to give the moulder a chance to tuck them up. A pattern to be used for rolling over work, and one for bedding in, should seldom be made upon the same plan, although they generally are. A pattern to be bedded in should be well braced, and made of good strong lumber, for the reason that bedded in patterns have to stand more or less sledge pounding, and where they are like a hollow box it is often impossible for the moulder to make the bottom of his mould as solid and reliable as it should be.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday evening, Dec. 19th, at the Institution of Civil Engineers, Mr. J. K. Laughton, M.A., F.R.A.S., President, in the chair. The following were elected Fellows:—viz., E. Bentley, W. [illegible] T. H. [illegible] J. M. [illegible] W. B. Tripp, and [illegible]

The papers read were:—

[illegible] Weather Prognostics," by the Hon. Ralph Abercromby, F.R. Met. Soc. The author explains about 44 weather [illegible] relating to the following [illegible] moon, and stars [illegible] by referring them to the [illegible] in which they are observed. By [illegible]

"Preliminary Inquiry into the Causes of the [illegible] Black-bulb Thermometers [illegible] F.R. Met. Soc. [illegible] the author has made a comparison with a number of these thermometers, the results of which are given in the papers. It is shown [illegible] to raise the temperature, and that the size of the thermometer bulb is a most important factor in the case of this instrument.

[illegible] Phenological Observations for 1883," by the Rev. T. A. Preston, M.A., F.R. Met. Soc.

Mr. [illegible], F.R. Met. Soc., exhibited a series of [illegible] illustrating the recent atmospheric phenomena during November and December.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE third meeting of the session was held on Monday, 17th Dec., the Rev. T. E. Espin, B.A. (vice-president), in the chair. A paper on the proper motion of sunspots was contributed by Miss E. Brown. The observations were made on 8th Nov. last, by projecting the sun's disc on a sheet of white paper. Two small spots were first visible near the E. limb, followed by a larger one, then just coming into view. By the time these spots had advanced fairly on the disc they formed a well-marked group, and it was plainly evident that the two first observed were much nearer to each other than to the third; but, on the 12th Nov. the relative position of the three spots was altered, the central one having gone backward till it was about half-way between the other two. This seemed clearly to show a retrograde motion in the central spot, and it may be as well to remark that, during this time, neither of the spots exhibited any changes of outline, as is so frequently the case. The positions and shapes of the spots were illustrated by carefully executed diagrams.

A paper by Mr. J. E. Gore, F.R.A.S., was read. The remarkable variable star χ Cygni had lately passed through a maximum. The period of its variation was not uniform; but, on the whole, the observations showed that it had been slowly increasing. At its brightest it seemed to vary from the 4th to the 6th mag.; but is usually about 5 mag. as at the recent maximum. The variable is Bayer's χ Cygni, and has been frequently confused with 17 (Fl.) Cygni, to which Flamsteed affixed the letter χ, by mistake; the variable, which is the true χ, having been faint at the time. Referring to the previous paper, Mr. Espin said, a request was received from Mr. Gore in September to observe the maximum. The systematic observation had been undertaken by Mr. Gage. The comparison stars were 17 Cygni of 5·2 mag., and 8 Cygni of 4·6 mag.; but most of the estimations were made from 17 Cygni. The value of different stations, widely apart, was shown from the fact that, while during a fortnight the weather was unfavourable at Ballisodare, four nights' observations were secured at West Kirby. There were some discrepancies in the resulting magnitudes; but these were probably due to the plan they adopted of placing the opera glass out of focus, which, in a great degree, eliminated the colour. The variable is a fine orange, and he found the difference between the brightness in and out of focus, was about half a magnitude for orange stars.

A paper was read by the Rev. S. J. Johnson, F.R.A.S., on the "Afterglow and Auroræ." The extraordinary character of the dawn and sunset for some ten days previous to the 6th December had attracted much attention. The rule had lately been that, for an hour after sunset and an hour before sunrise, the heavens had been suffused with an intensely ruddy vapour, the illumination being often grand, yet no actual aurora had been witnessed, at any rate in Dorset. The nearest approach to an aurora was on Saturday, 1st Dec., when at 5h. 15m., a very fine semicircular auroral cloud stretched across the sky from a point due N. to the S.W., ending in a mass of cloud at a low altitude. After a few minutes the cloud passed towards the E. and died away. In the W. there was at the time a ruddy cloud indented with dark finger-shaped rifts; the whole thing had probably been an edition of what is termed the "afterglow" referred to by Sir J. Herschel. That it had not been auroral was clearly shown by the absence of flickering or streamers.

Mr. W. E. Jackson wrote that in Constantinople they had had the most glorious sunsets imaginable. On the 1st Dec., the crescent moon, then a little more than 1½ days old, was, in his 4in. refractor, of a pale green, and the bright limb seemed to extend to an extraordinary distance round the dark body. On the 4th, the moon, Fomalhaut, and Vega seemed to float in a rose-coloured sea, and the thin fleecy clouds, which slowly drifted across the moon's face, were of a beautiful pale green.

Mr. Gemmill, in a short paper on 95 Herculis, directed attention to the estimates of the colours of its components. He said that, as these colours had been put upon record by different observers, they seemed to differ greatly, and, as a consequence, it has been suspected that the colour of one, or both, is variable. He thought, however, that many of the apparent discrepancies were due to the want of a reliable standard of colour.

In a communication to the Society, Mr. A. Stanley Williams called attention to the effect of mist in altering the relative brightness of lunar objects. He had lately been giving some attention to the determination of the brightness of different objects on the moon, basing his estimations on the standard objects photometrically measured by Prof. Pickering at Harvard. To take what was perhaps an extreme instance, a slight mist or haze would spread over the sky, and the standard objects, Plato and Mercator, and 4·5 and 4·4 mags. respectively, would be scarcely distinguishable in brightness from Billy and Grimaldi of 5·4 and 5·2 mags. Again on a to all appearance similar night, while the two first-named objects would be of their normal brightness, the two latter would appear almost perfectly black, and much darker than they should. Even in the pure sky of Brighton, these curious changes were a great inconvenience and source of possible error: but, on coming to London, the whole phenomenon was greatly intensified, and the standard objects were in a state of almost constant change, sometimes altering from one extreme to the other in the course of a few minutes.

SCIENTIFIC NEWS.

THE Comet Pons-Brooks passed very near Zeta Cygni last night, and is now entering the constellation Pegasus, being near Zeta Pegasi on January 8. It is getting very low down, and shortly after that date will be invisible in these latitudes: but the calculated intensity of its light will be at a maximum about the middle of January. The comet, though not conspicuous, is visible to the naked eye, and it appears was first so seen by MM. Henry, of Paris, on Nov. 27. Its position at Greenwich midnight on Jan. 2, 1884, will be R.A., 21h. 53m. 26s.; N. Dec. 20° 45·2′. The comet will be nearest to the earth on Jan. 9.

It is stated that Admiral Mouchez has drawn up a memorial praying for the removal of the Paris Observatory, but it has not yet been presented.

At the meeting of the Paris Academy of Sciences on Dec. 3, M. Faye gave in his report as representative at the Geodetic Conference. He supports the proposal for making the universal time that of Greenwich, but thinks that the civil hour ought to be the point of departure. For counting longitude, he thinks it ought to be 12 hours to the east and 12 to the west. It is probable that astronomical time will be adopted, and that longitudes will be reckoned consecutively over the 360°.

Considerable doubt exists as to who will succeed Prof. Owen as Superintendent of the Natural History collections of the British Museum at South Kensington. It is stated that there is a desire on the part of the official community that Dr. Günther should be appointed; but in other quarters it is asserted that the post will be offered to Prof. Flower.

Some idea of the industry of Prof. Owen may be gathered from the fact that he published, between 1830 and 1873, no fewer than 355 papers, the titles of which are given in the Royal Society's list, and since then he has contributed several others to the *Transactions* of the Royal and the Geological Society.

Amongst the lectures to be delivered before Easter at the Royal Institution, there will be a series of five by Prof. M'Kendrick on "Animal Heat," and six by Prof. Tyndall on the "Older Electricity, its Phenomena, and Investigators." Amongst the discourses announced for the Friday evening meetings, there will be one by Mr. J. N. Langley on the "Physiological Aspect of Mesmerism," and another by Prof. Osborne Reynolds on the "Two Manners of Motion of Water," shown by experiment. One of the most important discourses is that promised for Feb. 29 by Prof. D. E. Hughes, in which he will elucidate the "Theory of Magnetism," and illustrate his views by experiment.

A Mr. C. C. Hinsdale, of Cleveland, Ohio, whence several notable electric inventions have emanated, has obtained a patent for a new insulator, which is said to consist of paper pulp impregnated with liquid silica, which produces a covering having all the advantages of glass, without its brittleness.

An alarming accident happened the other day in Baltimore to a foreman of telephone line-men. He was holding one end of a wire which one of the gang was endeavouring to fix to a pole. The man unfortunately dropped the wire, which fell on to a line conveying a current from the Brush Electric Light Co.'s works, and the result was that the foreman received a shock which felled him to the ground, paralysed his arm, and bruised and blistered his body in several parts.

Mr. L. Daft's electric train, which we mentioned on p. 238, met with an accident during an experimental trip through taking a sharp curve at too high a speed. The gradient of the experimental line is 70ft. to the mile, and the accident occurred on the return journey. Mr. Daft uses a central insulated rail as the conductor, and a distance of a mile and a furlong was covered in eleven minutes.

The largest locomotive in the world is being built at Sacramento for the Central Pacific Railroad. The engine and tender will weigh 165 tons, and be 65ft. 5in. long.

At the Whitebank Engine Works, Kirkcaldy, Messrs. John Key and Sons have succeeded in making the largest casting known in that town—a low-pressure cylinder 100in. diameter by 6ft. 6in. stroke, measuring 12ft. 3½in. across the trunnions. The weight of the metal run down was over 25 tons.

A Mr. J. F. Schultz, of New York, proposes to tackle tornadoes by placing a barrel of powder at the limit of the town, firing it by means of a priming tube and a cord 100 yards along just as the tornado arrives over it. Probably, if the charge were large enough, the tornado would be checked; but the difficulty is to have the watchman always ready.

M. Dupuy de Lome, at the instance of M. Zédé has been making experiments on the Rhone with a system of towage by endless chains, in which a heavy chain rests on the bottom of the river, and is carried over pulleys on the tug. A tugboat is provided fore and aft on each side with an endless chain, sufficiently heavy, and plunging into the water so as to rest on the bottom for a space, the part on board being sustained by pulleys. These pulleys being turned by hand or by an engine, the chain moves with them propelling the boat against the stream. The chain on each side is actuated by a separate motor, the craft is steered by making one chain move faster or slower than the other. The chains are disposed in such a way that for the greatest depths the weights resting on the bottom produce an adhesion to the latter still greater than the drag of the tug and its convoy.

It is stated that the great volcanic mountain, Popocateptl, has been sold to an American company, who will mine the sulphur, and set up vitriol works in the neighbourhood. It is proposed to drive a tunnel into the crater, and to connect it by means of a railway with the Interoceanic line. If that is carried out, Popocateptl will probably have as many tourist visitors as Vesuvius.

Copies of the new rules for obtaining patents can now be purchased at the Patent Office Sale Department, Cursitor-street, Chancery-lane, W.C., price 6d., by post 7d. No applications under the New Patents Act will be accepted if they bear an earlier date than Jan. 1, 1884; but as the forms of application may not be ready at the Post Offices until the 29th inst., MS. applications will be received if prepared in conformity with the rules.

Imitating Expensive Leather.—The leather which it is desired to imitate is thoroughly cleaned and carefully coated with graphite, the work being similar to that necessary in preparing a smaller article for electroplating. It is then placed in a copper bath, the tank of which is large enough to easily receive a skin of any size. A dynamo-electric machine, generating a powerful current, furnishes the electricity. The copper is deposited upon the coated surface of the hide to a thickness of from one-sixteenth to one-eighth of an inch. The plate thus formed reproduces, but reversed, every mark and minute vein of the leather, so that a print taken from it is an exact copy of the original in every detail. A hide of cheap leather is laid upon the bed of a machine much resembling the ordinary iron planer. Extending across the bed is a large iron roll journaled at either end in boxes which slide between two vertical standards. Strong screw bolts regulate the distance between the bed and the bottom of the roll. The copper plate is laid upon the leather, and two or three thicknesses of felt cloth placed on the copper. By the aid of long levers the bolts are screwed down until the iron roll bears upon the copper and leather with a pressure of many tons. The bed being moved forward until all the plate has passed under the roll, the hide is removed, and is found to have been raised, in looks, to grain leather of the finest grade, or to alligator, as the case may be. The copper plate, being extremely hard, will print many hides. In some instances the plates are engraved, but as this method is more expensive and the reproduction not so faultless, it is but seldom resorted to.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

LIGHTNESS OF WINTER NIGHTS.

[22168.]—I have for a long time, like your correspondent "M. A.," noticed an unusual degree of light on certain cloudy and starlight nights: last night (Dec. 19) was an instance. During former seasons, when the aurora was prevalent, I have been ready to suppose that when clouds were present it might be explained on that ground; but I think it is equally perceptible at other times. It would be interesting if simultaneous observations of this phenomenon were made at distant stations. I am glad that attention has been drawn to it, and hope that some of your readers may be more capable of assigning a cause for it than myself.

Hardwick Vicarage. **T. W. Webb.**

SATURN.

[22169.]—I am obliged to "F.R.A.S." and Mr. Franks for their courteous reference to my letter upon the above subject. Might I remind the former that in his letter in the "E.M." for November 23 he did not give the exact time at which his drawing was taken, but simply said "which I made on the night of November 9th"? Mr. Ranyard's paper before the R.A.S., reported in this week's number, shows exactly the species of phenomena the watch for which I urge. "F.R.A.S.'s" observation of the uniformity of the polar shading is both interesting and valuable.

I am obliged to Mr. Denning for his note. If my recommendation *re* drawings of Saturn "staggers" him, however, he must excuse me saying, to employ his own not *very* happy phrase, that his criticism "staggers" me. I did no such thing as *advocate* such representations of Saturn. I *suggested* that drawings of the *ball alone* might be published, so that space and expense might be saved—if you, Sir, should object to the expenditure of either. My reason was plain enough—that *ordinary sketches* are not fitted to advance our knowledge of the Ring System. Is Mr. Denning prepared to say that such sketches could throw any light upon the difficult and delicate phenomena mentioned in the letter of Prebendary Webb referred to? Yet these are the points upon which we require information. The general aspect of the Ring System we know well enough. "Cousin, thou wert not wont to be so dull!" (to quote Shakespeare).

"Stella" (query "Standard Stars," 52516) will perhaps kindly excuse my replying in *this* communication. I mean to deal with the subject later, and will do my best to help "Stella."

S. Maitland Baird Gemmill.

Glasgow, December 21.

SOLAR PHYSICS—AFTERGLOW.

[22170.]—Those of your readers who are interested in the question of "Endowment of Research" should beg, buy, or borrow a copy of the *Glasgow Herald* for Dec. 14th, as it contains a capital article on "Solar Physics." Through the kindness of a brother correspondent in Scotland, I have been enabled to peruse the said article, which occupies two and a half newspaper columns of closely-printed matter; and I venture to say that its calm and sensible review of the whole question will carry conviction to any unprejudiced mind.

It is strange that in the pages of the English Mechanic no reference has been made to Piazzi Smyth's explanation of the "afterglow." He appears to ascribe it to purely atmospheric conditions; yet it is curious that these conditions should so seldom prevail, and when they do, to manifest themselves all over the globe at nearly the same time. The meteoric theory is more plausible; but, again, this rain of meteoric dust is no new thing, and this beautiful phenomenon ought to have been seen on many previous occasions if that hypothesis be the correct one. Cannot our veteran observers give us the benefit of their long experience as to whether they recollect its previous occurrence, and when?

W. S. Franks.

THE SUNSET GLOW.

[22171.]—Whatever may be the cause of the unusual atmospheric effects we have experienced, they are apparently world-wide. The following is taken from the *Melbourne Argus* of Nov. 7th:—

"A peculiarly rich glow, which has appeared in the western sky for a considerable time after sunset, has been popularly ascribed to the Aurora Australis. The Government astronomer, Mr. Ellery, however, attributes the phenomenon to a different cause. The spectrum, Mr. Ellery points out, exhibits great breadth in the telluric or atmospheric lines, and especially of those shown by M. Janssen to be due to aqueous vapour in certain conditions in the higher strata of the atmosphere. He is satisfied that the cause of the gorgeous sunsets is simply a peculiar hygrometric condition of those regions. He predicted wet and broken weather, and, as a matter of fact, the peculiar sunsets have been followed by copious rains all over the Australian continent, and unsettled weather still prevails. The season, in fact, has been almost as remarkable as the sunsets, nothing like it having been experienced for many years."

It does not appear to have affected our weather here, unless the circumstance that we have had a few fine days recently can be traced to it.

In considering cosmic causes as acting, we must take into account the difference of time, and also the opposite season, as compared with Australia. As to the Java volcano, of course the distance to Australia is trifling compared with ours: but it is in just the opposite direction. **Sigma.**

THE EARTHS OF THE HEAVENS ("LES TERRES DU CIEL." PARIS: MARPON ET FLAMMARION, EDITORS).

[22172.]—Those of our readers who are acquainted with the French language will, no doubt, welcome the new edition of Flammarion's "Terres du Ciel." The work is wholly consecrated to planetary astronomy, and is quite *au courant*. Readers of the English Mechanic will find there the most recent observations and drawings by Schiaparelli, Trouvelot, Denning, &c. The ideal views of the universe, as seen from the different planets, are well calculated to give to the non-geometrical reader an exact idea of the movements of our solar system. The historical part of the work is certainly very interesting, especially as many fine and curious old engravings have been reproduced. **C. Detaille.**

MICROSCOPIC MOUNTING.—V.

The Use of Reagents

[22173.]—1. *The Use of Reagents in General.*—At the close of my last letter I gave a recipe for the use of extract of logwood or crude hæmatoxylin, in order, as I said, that any reader who happened to be new to the subject might have something to stain with. But to use staining and hardening fluids and preservative media to the best advantage, it is necessary to be acquainted with the action of the reagents which compose them. In fact, the stains, fluids, and media, *are* reagents. About the use of reagents, then, the following general directions may be given:—

I. They must, as procured, be of determinate strength. With most solids there is no difficulty about this: a grain of bichloride of mercury, for example, is a grain of bichloride of mercury all the world over. But with liquid, such as glycerine or spirit, ammonia or hydrochloric acid, and with some solids, such as caustic alkali in sticks, it may not be easy to ascertain how strong they are. The means of discovering this are their obvious physical properties, their specific gravity (the chemist ought to know, or should be able to ascertain, the specific gravities of liquid chemicals as supplied to him by the wholesale house with which he deals), and the amount of chemical action which a given quantity is able to exercise. Many reagents, as ammonia, become weaker in time through evaporation; this should be taken into account, and prevented as far as possible. 2. No glass rod or anything else should ever be put into the bottles containing them (which ought to be kept in a dark, dry, clean, dustless cupboard, liquids beneath, for fear of accidents), as dust would thus be introduced. To withdraw a few drops, tilt the bottle till the liquid covers the stopper or cork; pull it out, but not altogether; and on slowly returning it a drop or more will escape. More than five drops or so should not be measured in this way, as drops differ in size according to the thickness of the fluid. 3. No acids or alkalis should be allowed to touch the glasses of the microscope; acids, moreover, spoil the brasswork. Strong volatile acids are especially dangerous, more particularly hydrochloric and nitric acids; they should not be used in the same room, or when the microscope is exposed where the contaminated air can reach it; and their vapour should be killed by ammonia Care, indeed, should be taken as to all volatile substances, which, though otherwise innocuous, may condense on the glasses and dull them. Let from it, or may be seen apparently unconnected with it. It moves with a rolling or streaming motion in a living and active cell; contains granules in its substance or on its edges, and looks like syrup floating in water or the splash of a raindrop on glass. To see it, cut a transverse section through the soft stem of an actively living plant where the colouring matter is not abundant: use as little water as possible, and after a few minutes examine with a quarter, or, much better, an eighth. Now acetic acid especially possesses the power (·5 to 5 per cent. or so) of rendering cell walls transparent and showing up the nucleus, the stronger solutions destroying the cell wall after a while, and setting the contents free; it also, like hydrochloric acid ·1 per cent., renders muscular tissue very transparent; the latter is apt to break striped muscle up into plates, while chromic acid resolves it into fibres. The action of alkalis on cells depends on their degree of concentration. They clear tissues and, like acids, coagulate the nuclear or internal bioplasm. As strong as they can be made (e.g., a saturated solution of soda), they at first do little more than this; but the tissue rapidly becomes a homogeneous transparent mass by their continued action. Weaker, about 20—35 per cent. for soda, or 26—40 per cent. for potash, they act on the tissue cement. Weaker still (say 15 per cent.) they dissolve the cell wall; and they also, even when stronger, produce in the cell a condition in which it absorbs water with great avidity, swelling or bursting when water is added. Weaker still they have the same effects, but act more slowly and manageably (say 5 per cent. for soda), and when the strength is yet further diminished, they seem to fail to coagulate the internal protoplasm, which very dilute solutions appear even to dissolve. **F. Grant.**

P.S.—I am only too glad to receive a hint. The wash-leather answers as well as the handkerchief for cleaning covers, and better for very thin covers, of which, however, I was not speaking. Disadvantage of leather, dust; of handkerchief, threads.

THEORY OF THE EYEPIECE.—DISPERSION OF LIGHT.—II.

[22174.]—IT may be well to mention that this only professes to be an elementary theory—that is to say, one in which we only proceed to first approximations, and so it may be said once for all, that all such quantities as are usually neglected for the purpose will be neglected here, such as products of aberration, thickness of lenses, &c.

Let two lenses be placed at A and B, and let a ray R P, which, if produced, would meet the common axis in C, be incident at P, and after the first refraction let it meet the axis in D, and after second refration in E. Let $PCA = \alpha$, $PDA = \alpha_1$, and $KEB = \theta$, $AC = b$, $AD = c$, $BD = b_2$, $BE = c_2$, $AB = d$. Then—

$$\frac{\tan. \alpha_1}{\tan. \alpha} = \frac{b}{c} \text{ and } \frac{\tan. \theta}{\tan. \alpha_1} = \frac{b_2}{c_2} \therefore \frac{\tan. \theta}{\tan. \alpha} = \frac{b\, b_2}{c\, c_2}$$

Now, by the formulæ for lenses, $\frac{b_2}{c_2} = 1 + \frac{b_2}{f_2} = 1 + \frac{c - d}{f_2}$, whence—

$$\frac{\tan. \theta}{\tan. \alpha} = \frac{b}{c}\left(1 + \frac{c - d}{f_2}\right) = \frac{b}{c} - \frac{b}{c}\frac{d}{f_2} + \frac{b}{f_2}$$

Also, $\frac{b}{c}\ 1 + \frac{b}{f_1}$, by means of which the last formula becomes—

$$\frac{\tan. \theta}{\tan. \alpha} = 1 + \frac{b}{f_1} + \frac{b}{f_2} - \frac{bd}{f_1 f_2} - \frac{d}{f_2}$$

This gives the course of the ray after the second refraction corresponding to the values $f_1 f_2$ which are the focal lengths belonging to any given colour.

Suppose that for any other colour f becomes $f + \partial f$, and θ becomes $\theta + \partial \theta$, we have, if we take the variations by the rules of the differential calculus—

$$\frac{\sec.^2 \theta\, \partial \theta}{\tan. \alpha} = -\frac{b}{f_1}\frac{\partial f}{f_1} - \frac{b_1 \partial f_2}{f_2 f_2} - \frac{bd}{f_1 f_2}\left(\frac{\partial f_1}{f_1} + \frac{\partial f_2}{f_2}\right) + \frac{d}{f_2}\frac{\partial f_2}{f_2}$$

But when the lenses are of the same material, $\frac{\partial f_1}{f_1} = \frac{\partial f_2}{f_2}$, and the above becomes—

$$\frac{\sec.^2 \theta\, \partial \theta}{\tan. \alpha} = \left(\frac{b}{f_1 f_2}(2d - f_1 - f_2) + \frac{d}{f_2}\right)\frac{\partial f_1}{f_1} \text{........(A);}$$

which is, therefore, the general expression for the dispersion which a ray undergoes after excentrical refraction through two lenses.

To determine the condition of achromatism, we must put the right side = 0, which gives—

$$2d - f_1 - f_2 + \frac{d f_1}{b} = 0 \text{........(B),}$$

which agrees with the formula usually given.

One advantage, however, of finding the general formula for dispersion is this: that it enables us without fail to determine the actual dispersion for any value of d, which is supposed to make the pair either actually or approximately achromatic. But since all things are only great or small by comparison, let us first establish a standard wherewith to compare it. The most convenient will be a single lens, so placed that the rays which fall upon it may come from its focus. The dispersion in such a case we may name the "focal dispersion."

The general formula, then, when f_2 becomes infinite, reduces itself to—

$$\frac{\sec.^2 \theta_1 s\, \partial \theta_1}{\tan. a} = -\frac{b}{f}\frac{\partial f}{f}$$

If, moreover, we suppose the above lens to be the equivalent one to the pair that is, the one which produces the same deviation, i.e., that which gives $\sec.^2 \theta_1 = \sec.^2 \theta$—and observing that for the focal dispersion $b = f_1$, and that $\partial f / f$ is the same for all lenses, we shall have—

$$\frac{\partial \theta}{\partial \theta_1} = \frac{b}{f_1 f_2}(f_1 + f_2 - 2d) - \frac{d}{f_2} \text{........(C),}$$

which gives the ratio of the dispersion of the pair to that of the equivalent single lens.

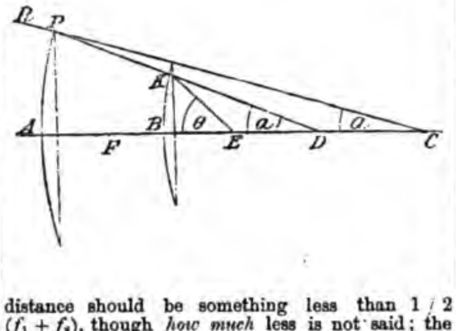
We may now apply this to some particular cases. The first will be that in which we have the so-called "achromatic combination," i.e., that in which $2d = f_1 + f_2$. In this case the formula reduces itself to $\partial\theta / \partial\theta_1 = -d / f_2$ where b disappears altogether. In the usual form of Huyghenian $d = 2f_2$, so that the dispersion is double that of the equivalent single lens.

To apply it to other cases we must first assign some value to b, and must again repeat that the necessary value which it must have is that which will cause its conjugate quantity c to terminate in that focus of the eye-lens which lies furthest from the eye, in order that the image may be in the proper position for distinct vision. This will give, by means of the formulæ for lenses—

$$b = \frac{f_2(d - f_1)}{f_1 + f_2 - d} \text{.................. (D)}$$

In the case of a Ramsden, where the lenses are equal, and $d = 2/3 f$, b becomes $= -1/4 f$, and the dispersion becomes $5/6 f$.

Again, in a Huyghenian, it is said that the *correct* distance should be something less than $1/2 (f_1 + f_2)$, though *how much* less is not said; the artist seems to be left to go by the "rule of thumb." Let us suppose it, instead of being $= 2f_2$ to be $3/2 f_2$, the value of b will become $1/5 f_1$, and the dispersion will be 13/10, which is better than the other, but still greater than that of the single lens.



Equation B will always suffice for the problem of finding a value of d, which will cause achromatism, provided only that b is a *known quantity*, whether it be great or small; but it is far otherwise when we have to take into account the consideration that the image must lie in the focus of the eyelens; or, in other words, that the ray, after first refraction, must pass through that focus. In order that it may do so, the value of b, as has been shown, must be that given in equation C, and it involves d; so that to give B as a complete solution, would be the same thing as finding the unknown quantity in terms of that unknown quantity itself; we must, therefore, look upon B, not as a complete solution, but only as a step towards it; and the next step must be to eliminate b between B and C. This will give, after a little reduction

$$(d - f_2)^2 + f_1 f_2 = 0,$$

$$\text{or} \quad d = f_2 \pm \sqrt{-f_1 f_2} \text{ .... (E).}$$

This is the value of d, which must be used when we take into account the condition as to the situation of the image. It involves only known quantities, and will only give possible values of d, when one of the lenses is convex and the other concave.

Also, there are *two* values of d, each of which will give a different e.p. We may also have cases where one or both the values of d will be negative; but these seem to be inadmissible, or, at least, to have a difficulty about them which will make it advisable to restrict ourselves to positive values. I may, at some future time have something to say about the case of parallel rays, in which, as far as I see at present, strange as it may seem, we can only have achromatism when the convex lens is of longer focal length than the other.

W. G. Penny.

[22175.]—ALL articles on light and lenses I read and study just now with a practical interest, having a bit of optical work on hand, which I wish to make as good as I can. I can assure the author of the paper on "The Eyepiece," p. 283, that his was no exception. I gave it the best attention, and for the very reason he anticipated it might get no notice. His results certainly are at variance with the views hitherto held by mathematicians, and I must say they do not agree with experiment in so far as I have made it.

When "trying," a short time ago, with a three-quarter inch o.g., slightly over-corrected I think, I found that by using different lenses in the eyepiece and placing them at different distances, I could indeed exaggerate or reduce colour to a minimum. With an uncorrected o.g. I found that while a single eye lens gave any amount of colour, I could greatly reduce it by using two, and when I put in two lenses, both uncorrected, for an o.g., and used a stop, I got a very fair correction.

So much for my own experiment. Now to turn to Mr. Penny's article, p. 283.

A ray falls upon the lens P, is refracted and resolved into two coloured rays, and passes through another lens Q. The rays after the second refraction "will be either convergent, divergent, or parallel." They are first supposed to converge and to meet in some point F. If they do so meet, and I think they must, will not an eye placed at F see the ray in the same condition as before it entered P, and if so, is not the combination achromatic? The achromatism may be what Deschanel calls "in a manner spurious," as the rays will not unite, but overlap.

But while the rays are supposed to converge after the second refraction, it seems to me they must converge. Before they could emerge parallel the second lens Q would require to be an achromatic combination if not over-achromatised. Before they could diverge the second lens Q would require to be at a less distance from the lens P than P's focal length. There is a point, though not a very material one, save for correctness of supposition. The ray Pq is supposed the red ray. It is on the diagram the ray of greater refrangibility, whereas in experiment the red ray is the least refrangible of all.

Again in paragraph 10, it seems to me that the supposition is, in the circumstances, an impossible one. A ray P q is supposed to proceed as a ray of *common light*, and to be resolved by the second lens into a red and a blue one. Now, from the last words of the paragraph, "the dispersion of *the pair*," &c., this ray is supposed to pass through the lens P, and if it does it could not emerge and proceed to the lens Q as a ray of common light—*i.e.*, an unresolved ray. Unless the lens P were an achromatic combination itself, it would resolve the ray before it got to Q. The conclusion following from Mr. Penny's reasoning is not then, I think, reliable when it proceeds upon an impossible supposition. All we could say is that in an eyepiece both the lenses must be uncorrected, or both must be corrected. I beg to assure Mr. Penny that I am not examining his paper in any hostile spirit, but am anxious for present practical purposes to know the truth about eyepieces and object-glasses. If I am wrong in my ideas, I shall be glad to have them corrected, and I await coming articles with as much interest as ever. I have been examining—theoretically—eyepieces with concave lenses, but I shall not anticipate what may be coming.

7th December. **J. A. C.**

ON THE RELATION OF APERTURE TO POWER IN MICROSCOPE OBJECT-GLASSES.

[22176.]—As a great deal of attention is now being devoted to this most important subject by the brass-and-glass section of microscopists, permit me to lay before your readers a few suggestions for their consideration.

In approaching this question we must first fix values to two factors. 1st. The smallest visual angle for definition with a normal eye. 2nd. The multiplication of the initial magnifying power that high-class objectives will bear, without fogging the picture. In answering the 1st we must remember it is not the visual angle of the smallest thing we can see that is required, but of the smallest thing we can define. In determining this angle, I have made use of finely ruled lines, and find that 250 lines to the inch can be separated at a distance of 10in. This gives a visual angle of 1′ 23′. My own eyesight can do rather more than this, but I think that it will be found a fair average to adopt. I may mention, in passing on, that a larger angle than the above will be required to split stars. This, I imagine, is due to a certain amount of flare being present, even with the keenest vision, and also to there being only one interspace.

It is a far easier business to fix a value to our [illegible]. No microscopist would rate an object glass as a high class that would in the slightest degree fog a picture with at least a 1in. eyepiece on the standard [illegible] tube.

This will be enough for us, as eyepieces deeper than 1in., while useful for adjusting and testing a lens, are admitted to be of questionable utility for work. Now, the question simply resolves itself into this: What aperture must be given to an object-glass to enable it to define anything that would be brought to a visual angle of of 1'23 by an amplification of [illegible] times the initial power of the lens?

A simple rule for finding the initial power of a lens.—Divide its focal length by 10. Produce the fraction to unity for the numerator. The denominator then expresses the initial power.

Example.—The initial power of a 2in. ?
— [illegible] = [illegible].—Ans. 5.

The initial power of a [illegible]?
— [illegible] = [illegible].—Ans. 15.

The initial power of a [illegible]?
— [illegible] = [illegible].—Ans. [illegible], &c.

The following are the apertures for object-glasses that would fulfil the above conditions:—

[illegible] N.A.	[illegible]	air angle	10°.
[illegible] ..	[illegible]	.. ..	15°.
[illegible] ..	[illegible]	.. ..	20°.
[illegible] ..	[illegible]	.. ..	30°.
[illegible] ..	[illegible]	,, ...	40°.
[illegible] ..	[illegible]	,, ...	65°.
[illegible] ..	[illegible]	,, ...	81°.
[illegible] ..	[illegible]	,, water angle	[illegible]°.
[illegible] ..	[illegible]	crown glass angle ..	[illegible]°.
[illegible] ..	[illegible],	which has yet to be constructed.	

In giving this table far be it from me to insinuate that objectives with less aperture are to be despised. The eye is so slow to recognise any new feature, unless it is very prominently put before it, that magnifying power with far less aperture is most useful. But, if ideal perfection is to be reached, the values given in the above table must be aimed at.

Dec. [illegible]. **Edward M. Nelson.**

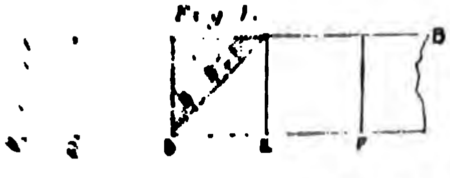
EQUATORIAL STANDS.—III.

[22177.]—*There are two or three misprints in my last letter, which it may be as well to notice. In the third paragraph, on page* 304, "sometimes as" should be "*sometimes a*"; and in the P.S., "I have *formed*," should read "I have *found*."

The next matter to be dealt with is the mode of constructing and applying verniers. It is evident that any attempt to directly subdivide a short length of arc or of a straight line into a great number of parts must render the divisions too minute to be readily distinguishable, and we therefore adopt the principle of the vernier, in which we have two adjacent portions of arcs or straight lines, one on the fixed and the other on the movable part of the instrument, such divisions differing in number for an equal length of arc or line, while neither set of divisions need necessarily be small as compared to the amount of motion to be measured.

It may, however, be as well to describe first other modes of measuring small amounts of motion before entering on the details of the actual vernier. In Fig. 1, let A B be any given length of a straight

Fig. 1.



[illegible] divided by the lines C, D, E, F, &c., [illegible] this the triangle shown by [illegible] that the base of the [illegible] the upper line B of [illegible] with the [illegible] of this triangle ex- [illegible] of one of the division [illegible] from the bottom of [illegible] this hypothenuse be [illegible] as it is desired to [illegible] divisions on the [illegible] is divided into [illegible]

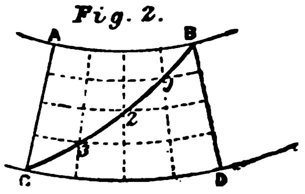
[illegible] left to right; then [illegible] coincides with the [illegible] the triangle [illegible] one-fourth [illegible] when the divi- [illegible] will have [illegible] divisions; [illegible] brings the lower corner of the triangle into coincidence with E, and the top corner with F, completing one division of the scale, whence the process can of course be repeated.

Thus one short inclined scale, equal in length in this instance to about 1¼ times one of the main divisions of the long scale, serves to subdivide the latter's divisions each into four; and to do this, however many of the main divisions the long scale may have—moreover, each of the divisions on the inclined (sliding) scale will be nearly 1¼ times as long as one of the subdivisions of the main scale would be were the number equal—that is, were the main divisions such as to measure equal amounts of motion of one scale over the other.

If we attempt to apply this system to curved scales we meet with a difficulty, because the inner and outer radii will necessarily differ, and the lengths of arc on the inner and outer curves will therefore differ in length, as is evident from the nature of the case. To obviate this difficulty it becomes necessary to make the sliding (which has now become a rotating) scale with a curved edge, the curve being such as to measure equal angular motion by the intersection of the curve with one or more radii of the curved scale.

Fig. 2 shows such an arrangement with the means of obtaining a certain number of points through which to draw (approximately) the curve required. A B is the inner and C D the outer arc bounding the principal division to be subdivided, and let the required number of such subdivisions be (as in the former case) four.

Fig. 2.



Divide the arc C D into four equal parts, and draw lines as radii to the centre of the circle as shown. Divide also A C or B D into the same number of equal parts, and describe the arcs concentric with A B or C D. Through the points of intersection B, 1, 2, 3, C, draw the curve, then this curve and the points 1, 2, 3 will correspond in the case of the circular scale to the straight line, and the points 1, 2, 3 in the case of the straight scale of Fig. 1.

On a large scale it is possible to obtain a sucession of radii of varying length (whose centres themselves lie in a curve), and with these radii to strike out the curve B to C; but for so small an arc the method would scarcely exceed in accuracy the one described, being in fact only an approximation itself, as the curve is really a portion of a spiral, and therefore impossible to be described from centres.

The same end might be attained with a straight line as in Fig. 1, by having it divided into unequal divisions so as to compensate for the difference in the lengths of the arcs, but it is not necessary to go specially into this, as the advantage would be somewhat doubtful.

We now come to the regular Vernier (or Nonius, as it was formerly called), of which the principle may be thus stated.

If two equal straight lines or circular arcs A and B are so divided that the number of equal divisions in B is one less than the number of equal divisions of A, then will the excess of one division of B above one division of A be compounded of the ratios of one of A's divisions to A and one of B's divisions to B.

Let A contain 11 parts or divisions, then one of A's to A is as 1 to 11 or $\frac{1}{11}$. Let B contain 10 parts, then one of B's to B is as 1 to 10 or $\frac{1}{10}$.

But $\frac{1}{10} - \frac{1}{11} = \frac{11-10}{10 \times 11} = \frac{1}{10 \times 11} = \frac{1}{10} \times \frac{1}{11}$.

Or, generally, if B contain n parts and A contain $n + 1$ parts, then $\frac{1}{n}$ is one part of B and $\frac{1}{n+1}$ is one part of A.

And $\frac{1}{n} - \frac{1}{n+1} = \frac{n+1-n}{n \times n+1} = \frac{1}{n} \times \frac{1}{n \times 1}$

This may be easily tried with two ordinary drawing scales; say, one with the inch divided into 3 and the other with the inch divided into 4. Place them alongside so that the 1 of the ¼ scale coincides with the 1 of the ⅓ scale, and then slide the former till the two 2's coincides. It will be found that the 1's will now be separated by an interval of $\frac{1}{12}$ of an inch, or ¼ × ⅓.

Similarly, if the scales are respectively 2 and 3 divisions to the inch, the difference, after sliding the one on the other will be found to be ⅙ of an inch or ½ × ⅓.

It is i

other the number of divisions in the vernier be one more or one less than the number of divisions in a corresponding length of the scale. Take a slip of card and divide it into inches, numbering them from left to right 0, 1, 2, 3, &c., to 6 or 7. Take another slip of card for the vernier, mark off 3in., which divide into four equal parts, also numbered from left to right 0, 1, 2, 3, &c. Then, when the two 0's correspond, the 4 of the vernier comes to 3 on the scale of inches, and by successively making coincide the two 1's, the two 2's, and the two 3's, the 0 of the vernier will show ¼, ½, ¾, of the first inch between 0 and 1 of the scale.

Make a second vernier 5in. long and divide it into four equal parts, numbered as before; on sliding this along the scale, it will equally divide the inch into four parts, but it will be the inch extending to the left of the zero of the scale, instead of the inch from 0 to 1, as in the former case.

The simple rule to remember is that the vernier has as many divisions as we require subdivisions of each inch (or other length to be divided), and that it must extend over either one less or one more than this number of inches (or other main divisions) of the scale. In the above we have in one case ¼ × ⅓ = $\frac{1}{12}$ of 3in., and in the other ¼ × ⅕ of 5in., each being equal to ¼ of an inch.

For an Hour Circle divided into degrees we may use either the ¾ or the $\frac{5}{4}$ division of the vernier in order to read to one minute of time, remembering that one will read forwards and the other backwards.

For a Declination Circle divided into degrees, if we wish to read to five minutes of arc, since 5' = $\frac{1}{12}$ of 60', we must make vernier with twelve divisions, extending over either 11° or 13°.

If we wish to read to single minutes, the vernier would have 60 divisions, and extend over 61: but as this would make it inconveniently large, it is better to have the circle divided into ½ degrees, in which case the vernier would only extend over 31°, and be divided into 30 parts.

It may be useful next to show *how to divide a line into an odd number of parts for the purpose of graduating a vernier.* Let us say we wish to divide a line into nine parts. To do this by trial and error is a tedious and inaccurate way, whereas it can be done with ease as follows:—Let A B, Fig. 3, be the given line. Divide it into eight parts (an even number) and lay off one of such divisions on A B extended as to C. At B erect an indefinite perpendicular line B K, and with radius A C and centre A intersect the perpendicular in point D, and draw A D, then A D obviously equals $\frac{9}{8}$ of A B. From centre A, and with radii A1, A2, A3, &c., draw arcs intersecting A D, then A D will be divided into nine equal parts. Parallel to the perpendicular line B K draw the verticals through the division points in A D, intersecting the given line A B, then A B will likewise be divided into nine equal parts, as required; or a line may be drawn from B parallel to A D, and similarly divided; then, joining the points of division in these two parallel lines, the line A B will be divided into the same number of parts.

Fig. 3.

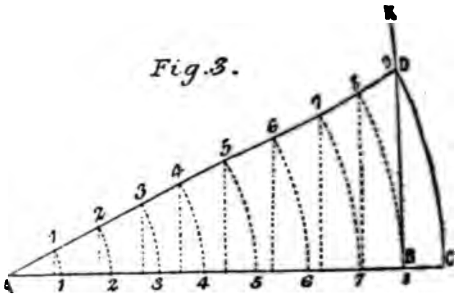
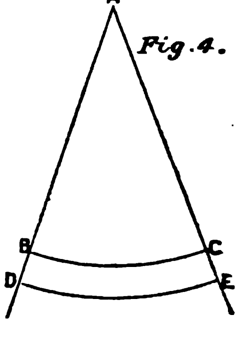


Fig. 4.



As a practical application of this geometrical method, we may take an ordinary drawing divided into eighths, and making the 0 coincide with the point A, and the 9 coincide with some point on B K may find at once the point D, and divide A D by the scale. Simple as this method is, it does not seem by any means generally known.

The same principle is also applicable to the division of arcs. In Fig. 4, let A B and A C be two radii, including the arc B C, which we may assume to be already divided into eight equal parts, but which we wish to divide into nine equal parts. Produce A B and A C indefinitely, and with a radius A D or A E equal to $\frac{9}{8}$ths of A B or A C describe the arc D E; then the length of D E will be $\frac{9}{8}$ the length of B C, and one of the divisions of B C stepped along D E will divide the latter into nine equal parts with all needful accuracy. Therefore, by drawing radii to the several divisions of D E, the original arc B C will also be divided into nine equal parts, as required.

There are certain practical details to be attended to in arranging the size of the vernier, and the most convenient number of divisions to be adopted, having regard to the sizes of the hour and declination circles; but as this letter is already a long one, I had better leave them for a future occasion.

A. S. L.

COMPOUND ENGINES OF TWO CYLINDERS.

[22178.]—I HAVE read letter 22136 from "Engineer, Dewsbury," and I must say I cannot follow his arguments. The letter states, on page 325, "The exhaust valve in the high pressure being now open, the steam will now pass into the low-pressure cylinder, whose volume to point of cut-off = whole volume of high-pressure cylinder. The volume of steam not being increased, but only removed, its pressure will remain the same, &c." Now this is the point. In this case, the point of cut-off in low pressure is $\frac{1}{3}$ stroke. Now, while the low-pressure piston travels $\frac{1}{3}$ stroke, the high pressures does the same, I imagine, ∴ $\frac{2}{3}$ of high-pressure cylinder is full of steam, and also $\frac{1}{3}$ of low pressure, and $\frac{1}{3}$ of low pressure = the whole of high pressnre. ∴ the steam that formerly occupied high pressure now occupies $\frac{2}{3}$ high pressure and $\frac{1}{3}$ low pressure, which is equivalent to $\frac{5}{3}$ high pressure, or has expanded $1\frac{2}{3}$ time the volumes.

This is as the case appears to me; but I should feel much obliged if "Engineer, Dewsbury," would inform me on this point. **A Beginner.**

[22179.]—HAVING read "Engineer's" letter (22136) in the ENGLISH MECHANIC of the 14th inst., I beg to differ from him as to the back pressure in the high-pressure cylinder; he takes 72lb. as the pressure at the point of cut-off in $\frac{1}{3}$rd of stroke; the terminal pressure will be 24lb. This steam exhausted into the low-pressure cylinder for one-third of the stroke, which is equal in capacity (at that point) to the whole capacity of the high-pressure cylinder. We shall now have 3,600 cubic inches of steam in the low-pressure cylinder, and 2,400 cubic inches at the exhaust side of the high-pressure cylinder. At this point the steam will occupy a space of 1,666—the space it did in the high pressur at the cut-off—with a corresponding reduction of pressure, and instead of a pressure of 24lb., as stated by "Engineer," at the cut-off, there will only be $14\frac{1}{2}$lb.; or to "ignore" decimals, say, 15lb., giving an average pressure throughout the stroke of $10\frac{1}{4}$lb., if we allow a two-pound back pressure from the condenser, the average effective pressure of $8\frac{1}{4}$lb., and not 14·79lb., as stated by "Engineer," which will be equal to 37 horse-power, and not 53·8, as he states. I will now deal with the back pressure in high-pressure cylinder. As before stated, we have a back pressure of 15lb. in that cylinder, when the low-pressure valve closes for steam; consequently the steam on the exhaust side of the high-pressure piston will have to be compressed for two-thirds of the stroke, and at the termination of the stroke the pressure will be something like 360lb. I should not be surprised if the cylinder cover gave way. The average back pressure throughout the stroke would be 62lb., or 12lb. more in back pressure than the average pressure on steam side of piston.

I will now draw "Engineer's" attention to a few disadvantages in connection with compound engines working. There is the loss of pressure from the point of exhaust in high-pressure cylinder to the steam line in the low-pressure one, in some cases as much as 20lb., without giving out any duty; in fact, I have a pair of diagrams before me taken from one of Hick's compound engines, where the steam was taken on for nine-tenths of the stroke in high pressure, at a pressure of 59lb., and exhausted at that pressure, and only gets 26lb. at the admission of steam in the low pressure. A loss of 33 betwixt the two cylinders. There is also the loss from leakage from two valves and pistons, power required to work the two valves, radiation from the two cylinders and valve-box and connections. In

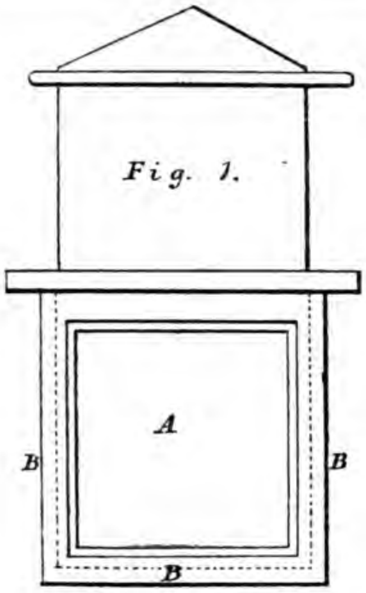


Fig. 1.

Fig. 3.

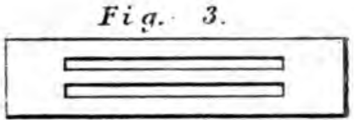


Fig. 4.

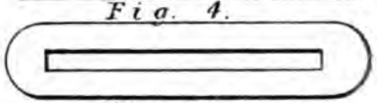
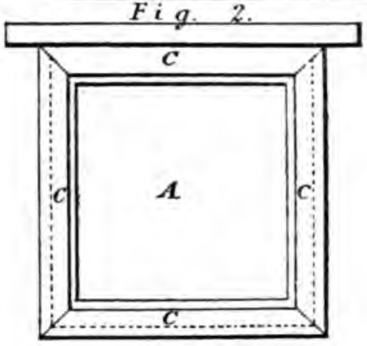


Fig. 2.



A CHEAP AND EFFICIENT DOUBLE DARK SLIDE.

[22180.]—I THINK the following will serve many of our amateur photographers. The wood I used consists of the thin boards placed as a backing to pictures. They are about 4ft. 6in. long by 11in. wide and 3-32in. thick, and should be procured as free from knots as possible. I gave 3d. each for mine. They will have to be sandpapered until a smooth surface is obtained. Cut two pieces the size the slide is intended to be to fit the camera, and out of these two pieces cut openings slightly smaller than the size of plate used—say $\frac{1}{8}$in., each way (A). Glue three strips of wood on the face of one of these pieces round three of its sides (B, Fig. 1), and then fasten another of the pieces of wood, with the openings over all; this will be the groove for the shutter to work in. Four more strips of wood are now to be glued on to the face of this last piece forming a rebate to contain the sensitive plate (C, Fig. 2): it should be slightly larger each way than the plate. This will complete one-half of the double book, the other is made in exactly the same manner, and the two halves are neatly hinged together. The top consists of a piece of wood about $\frac{1}{4}$in. thick, slightly longer than the body of the slide. It has two slits cut down its length for the shutters to pass through (Fig. 3), and care must be taken in fixing the top that these slits correspond with the openings in the slide. I have screwed this top piece on to one half of the slide, leaving the other half free to open. When the plates are in position the two halves are kept together by closing them and inserting the shutters.

I use cigar-box wood for the shutters planed down to make it work easily in the grooves, as I find light gets through those thin pine boards. A strip of wood is glued on to the top of each shutter (D, Fig. 4), which projects over the grooves which makes it light-tight. I find by gluing a piece of velvet over the slits in the top piece, then nicked with a knife to let in the shutters, makes it quite light-tight when the shutters are drawn out for exposure. The parts which enter the camera, as also the inner face of the shutters, should be stained black, and some opaque material interposed between the sensitive plates. Care should be taken that the plates occupy the same position as the focussing screen. This should br accurately measured from the front of the camera. With regard to tools, I find a fret saw and vice to answer every purpose. I trust I have made my description clear, and should anyone feel inclined to make a dark slide and be in donbt upon any point, I shall be pleased to help them through the query columns. I have given few dimensions, as these must necessarily vary in each individual case. **William Holmes**, Heanor.

TRICYCLES.

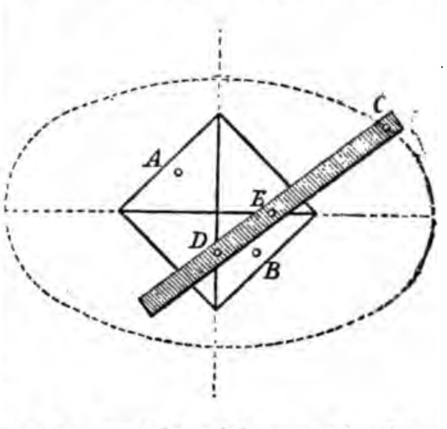
[22181.]—I HAVE been looking for some answer to your correspondent's inquiry about the Burdess Sterling Tricycle; but unfortunately there has been very little notice taken of it. I saw one in Glasgow recently, and was much pleased with the simplicity of its direct driving, doing away, as it does, with all cranks, chains, and wheels, which, in my estimation, are to be avoided.

I should like very much to hear how the machine works in actual practice, as I am wanting a machine on which I could do a run of twenty miles in the morning, and have a day's fishing, returning again may add that I have not yet arrived at the prime of life, and feel quite sound in wind and limb, but have not time to learn the Otto. My first attempt will most likely be for a run of 40 or 50 miles.

J. K.

SIMPLE TRAMMEL.

[22182.]—IF the following simple method of constructing a trammel for describing ellipses on a blackboard or any other surface is likely to interest your readers, I should be glad if you would insert it in your next. Choose a hard bit of wood about 6in. square and 1in. thick; make two clean saw cuts about $\frac{1}{2}$in. deep along the diagonals; bore two holes, A B, by which to fasten it to the blackboard. Cut a straight bit of wood 18in. or 2ft. long, $1\frac{1}{4}$in. broad and about $\frac{1}{4}$in. thick. Fasten a block, 1in. thick, under one end, and through it drill a hole (C) for chalk or pencil. Fix two French wire nails, chosen so as just to move easily in the saw cuts at D E, so that C D equal semi-major axis and C E semi-minor axis of required ellipse. It is wonderful with what ease and certainly the curve is described with this rough and easily-made instrument.



Leonard Marshall, M.A.

A FIRST LESSON ON THE PIANO WITHOUT THE INSTRUMENT.

[22183.]—MANY persons cannot read music because they learnt by the ear first, instead of the eye and touch or feel. This is so. Now for the remedy. Take two pieces of stiff cardboard and a penny slate; rule five lines across each, $\frac{1}{8}$in. apart, with pen and ruler, and bradawl for the slate. On the first card make a full dot between the lines, which read as F A C E upwards; on the second card make a full dot on all the lines, which read E G B D F, call this F the upper F. Number the first 1 2 3 4 space, and the second card 1 2 3 4 5 on the lines. Learn the space card first, and get anyone to hear you, dodging backwards, forwards, and in and out, then set different arrangements of these letter notes on the slate, as A E C F, &c., and with the pencil dot them off in their places, which can be corrected by the card; this is capable of many changes, and more so when the second card through the other's persistence. Now, get any printed piece of music and read off the notes in the treble sign. The extra note above all the lines will be upper G, and the extra note below will be lower D. Don't tire, for there is only one more note to learn this lesson, it is really lower than D, having a short line drawn through it, and looks like the planet Saturn: this is middle C on the piano. All you have to do now is to draw on cardboard a copy or diagram of part of the keyboard, commencing at middle C and upwards. This C has a line on its left side, and is followed by two black keys; then comes F, with a line on its left side and three black keys. Whatever you do, make the drawing yourself, and so have the image of the keyboard impressed on the mind. Draw the five lines as on the cards, on the diagram, and as low down as where the fingers should play; then dot the notes and learn their position, dodging, putting your finger over the dot till you can go to the real piano and read the notes off. Czerny's "Fifty Studies," op. 481, price 1s. 3d., at Enoch's, Holles-street, is the best for beginners.

Fiddler.

KEY CHARACTERISTICS IN MUSIC.

[22184.]—I AM not quite sure that I understand the remarks of Mr. G. Templeton, p. 345, for I am unable to see what "bird crumbs" (sic) and the injury to his forefinger have to do with key characteristics. Mr. Templeton "demurs" to my illustration, as he calls it, founded on Colin Brown's voice harmonium, and says that instrument does not give perfect intonation. I suppose we all know that reed instruments are very touchy affairs, and that the amount of fall of the key and the pressure of the wind both exercise some effect on the pitch of the reed; but my reference to the voice harmonium meant that the instrument was to be played properly or naturally, and without any conjuring, and if that be so, I say that it gives practically perfect intonation—so perfect that the human ear has not yet been made which can detect any unjust intonation. If Mr. Templeton will explain in definite language what it is he really means, I shall be happy to assist him in any way I can. I presume he knows what he means; but I confess I do not.

N. E. Child.

GLACIERS AND THEIR MOVEMENT.

[22185.]—IT would be difficult to find anything in nature of more curious interest and fuller of wonders than the great ranges of mountains which break up the surface of the level earth in every country, more or less, and the more especially in those vast continents wherein alone it is possible that they should exist—such as Asia and the Southern America and the Arctic land. So many are the wonders to be found in mountain forms and "influences"—to adopt a general expression—that it would be difficult to give any one of them any priority; but there is most surely not one of them more full of mystery and wonder than that of glaciers—their formation and their downward movement from the mountain tops to the valleys beneath. This difficult subject has been the study of many who have spent very much of their time on mountain travelling and observation—thus with their own eyes to watch from day to day, and from hour to hour, what goes on and what changes take place in, and with, the vast masses of snow which fall on the mountain tops, and then to finally fall, as in Greenland, into the sea in the form of icebergs, into which it has been changed. This is a scientific question of no small interest, and a few words on it in the ENGLISH MECHANIC may, therefore, be of some interest to a reader here and there—the more especially in these days of travelling.

It is certainly not the least of the many curious things which Nature offers us, and which at times we make note and record of, that however far advanced a science may be, there is most surely an infinity of details in it and about it to be yet inquired into. No theory is quite complete in illustration, and no analysis quite exhausted. Nature is inexhaustible and infinite, and all inquiries which depend on observation and eyesight for a record of the facts of them, are always being added to, and so are never complete. We see the facts, but cannot explain their cause or causes, and it is only by such facts passing through a succession of minds that the true explanation of the phenomenon is at last found. I would, therefore, but venture to hint at a somewhat new explanation of a not a little curious natural fact worth careful looking at, viz., the movement of glaciers. Glaciers have been seen and wondered at for a long time, indeed, for they are as old as the world itself, and the wonder of them is, as with so many other curious things, that all the mystery in them, and in their mode of motion down the sides of huge mountains, is, and must needs be, the result of forces ever and always in full operation, and as *ready to operate ages* before the glacier itself came into being. *What a glacier is* admits of no doubt; says *M. Rendu, the first of glacier students,* [illegible] matter is their mode of motion: but how this is (he continues) is entirely unknown. I would but attempt here to help to solve this knotty problem.

It is sufficiently well known that all vapour from the moisture-saturated air on and about the tops of snow-capped mountains, as in the Alps and Andes, is eventually precipitated in the form of snow. Snow is always falling and heaping up; but there are limits to the vertical increase of it: it cannot grow in thickness to an indefinite extent on the mountain summits. The mountain tops are being perpetually relieved of their snow coverings, partly by evaporation and partly by huge masses of this mantle of snow suddenly falling away in the form of huge snowfalls or avalanches. But neither evaporation nor snowfalls are sufficient of themselves to drain the mountains of their vast reservoirs of snow. This is accomplished by a series of snow and ice rivers, or glaciers. These have been described in a well-nigh endless series of volumes and papers, which alone show the degree of importance attached to a more correct knowledge of their formation and movement. Many a hot fight have these ice rivers occasioned, and the battle still goes on. How do the ice rivers move? and why do they move? is one of the momenteous questions involved in the very work of the world itself.

It is one of the properties of snow, full enough of mystery, to consolidate into ice on becoming subjected to pressure. A severely-pressed cube or mass of snow is converted by this pressure into ice. It is this fact which renders a glacier possible. The pressure of the snow, as it accumutates, presses on the mass beneath, and converts it into true ice. In addition to this mere pressure, there is, to a limited extent, the alternate thawings and freezings on the surface of the snow. Water also percolates downwards into the body of the snow. But it is mainly by pressure that the snow becomes ice. This being so, it would naturally be thought that this solid ice mass would remain absolutely immovable, and would form, indeed, a part of the very rock mountain itself. But not so; hard and solid and immovable as it seems, it is found to move *slowly* down, the mountain sides as a huge ice river or "glacier," at times of enormous length and thickness, and to eventually, as in Greenland, fall into the sea, there to form icebergs. It is found also to move not only down steep inclines, but along slopes barely appreciable by the eye, so slight is the incline; and the question then is, and it is yet an unsolved problem, *how* and *why* does this huge mass move as it does, and what and where is the propelling force? Right curious mechanical problems. I would here but venture to hint at a solution.

But before doing so it may be as well to advert to some of the solutions which eminent observers have already propounded. It will serve to show how hard a problem it is to solve, and it will also serve to illustrate and to explain more fully the precise nature of glacier motion.

There was first the theory of Scheuchzer and M. de Charpentier, commonly known as the "dilatation theory." It was supported by M. Agassiz. This theory supposes that the motion of a glacier down its bed or valley is caused by the conversion of the water within the glacier into ice, the irresistible expansion which takes place in the freezing of it furnishing the force which urges the glacier downward, and thus squeezing it out. It may here be noted, as opposed to this theory, there is this startling fact—that, as in Greenland, and the farther North, where the glaciers are from one to two thousand, and even five thousand, feet in thickness, no evidence is to be found of this squeezing out of any portion of the ice mass. All moves together. The pressure at the bottom of such a huge mass must be enormous. The Swiss glaciers are but as pigmies to such, and yet do the Greenland glaciers come down to the sea as pure ice in blocks, and, breaking off in huge masses, fall into the sea and float on it as icebergs. Had ice been but a fraction heavier than water, this world of ours could not have been habitable, it is curious to note.

2. In 1760, another conjecture was started by Altmann and Gruner, by which it was supposed that the glacier *slid* along its bed. This theory was adopted by the great Alpine traveller De Saussure. It has been called the "sliding theory." It may be thus defined: currents of water are found to flow between the ice of a glacier and the mountain bed which supports it. The frozen mass of the glacier being thus disengaged by the water from all adhesion to the stony bed beneath, and sometimes even being raised by the water, must, it was thought, glide down slowly, and well-nigh imperceptibly by its mere weight—i.e., by the force of gravity. It must here be noted, and it is strenuously contended for by many, and was considered proved by Canon Moseley, that the action of gravity alone is not sufficient of itself to move the glacier down the bed on which it is supported. The glacier does not slide down its bed as a plate of glass or slab material whether down the roof of a house with [illegible] ight to urge it downward. [illegible] least [illegible] would seem to be needed to account for the movement. What is it, and where does it originate?

3. The late Professor J. P. Forbes, an eminent authority on this subject of glacial action, came, after long observation, to the conclusion that the motion of a glacier was due to the "viscous" or plastic nature of the ice itself; that the ice moved down the slope of the mountain much in the same way as a viscous substance, such as tar, might do, and that its weight was alone sufficient to urge it forward. And this at first sight might seem indeed to fully solve this puzzling problem, as nothing more would appear to be needed to do it. But it is not so: mere gravity acting alone downwards will not do the work.

4. Professor Tyndall has proposed a different solution of the problem. When two pieces of moistened ice are brought into contact it is found, as Faraday proved, that they immediately freeze together. Broken pieces of ice, as they break in a glacier, reunite, and form thus a solid mass. Dr. Tyndall, therefore, concludes that the motion of a glacier is due to "fracture" and "regelation." Its own weight, therefore, drags forward the ice, which seems to flow with a viscous motion, owing simply to the "fracture and regelation" of all its particles.

Canon Moseley has "proved" that the mere weight of a mass of ice is not sufficient to cause the ice to move down a moderate slope. There must, therefore, be some other force urging the ice forward and downward. Again, therefore, we may ask, What is that force which compels the ice to move?

5. One more attempted explanation may be described. Mr. J. Croll says:—"Water, in the act of freezing, gives out heat, and while passing into the solid state expands. Ice, therefore, occupies, weight for weight, a greater space than water. Ice, in the act of melting, absorbs heat. The sun's action, when shining on the surface of a glacier, does not raise the temperature of it, which it cannot do, but converts a portion of it into water. This action, if continued, would in time cause the glacier to melt away altogether, as it, in fact, does when the ice of it reaches the warm valleys to form a river." Mr. Croll, therefore, supposes that the heat thus finding its way into one portion of the glacier is rapidly conveyed to another portion, and in the doing so compels the icy mass to change its position. It is not, therefore, the ice, as ice, of a glacier that is moved downward by the force of gravity—as supposed by this ingenious theory—but the water, particle by particle. This water is again converted into ice. It is difficult to see here why the water, thus permeating, by supposition, the mass of the ice everywhere, should not act as a river full of ice does flowing downwards. But where, it may well be here asked, does enough of water come from to do the work of floating, or even of "oiling," such enormous masses as go to make up a thick and wide glacier? This, therefore, cannot account for the movement of a glacier down the slopes and across the levels of a mountain incline. Is there nothing else in nature which is found to move in the like way, it may be here asked, thus to help us to a solution of this difficult problem? I hope to be able to show that there is, or at least that there is yet another theory tending to a solution of this problem.

C. B. A.

LIGHTNING CONDUCTORS.

[22186.]—IN reply to "F.R.A.S.," p. 339, it appears to me that the lightning conductor of Chichester Cathedral, which he very truly describes as an elaborate arrangement, was put up with very small regard to sound principles. A woven copper ribbon is a very good thing—for the makers, because it is expensive, and glass insulators, &c., come under the same category. With such accompaniments I should expect to find a very bad earth, because that makes no show. Nothing can well be simpler than a good lightning-conductor, which only needs a sufficient mass of metal, either as rod, rope or strip, the rope being handiest for fitting up, and the strip less likely to be fused, but more exposed to injury otherwise. But a cathedral spire ought to have at least an inch section of metal, and here economy, so-called, is always unwise, seeing that the mere addition of mass of metal, while vastly increasing security, adds little proportionately to total cost.

The insulators are mischievous, and it would be better to insert strips of metal in the edifice, and connect them to the conductor, especially where bells and other metallic masses are contained in the structure which ought to be connected to the conductor, provided the prime condition of all is duly attended to. This, of course, is "good earth." This ought not in such a case to exceed 1 ohm resistance; but I understand some of our cathedral conductors have been found in the 800, the effect of which may be to make the conductor a source of danger instead of protection. It may increase conduction in the upper strata, and invite a discharge which, failing to be carried off, may then distribute itself into the buildi
had anything to do with protecting an i

structure, I should insist upon two or three distinct good earths at different parts, and lead the conductors to all of them, making the ridge cap of the edifice a part of the system of conductor if possible. Above all, I would put the money in solid metal and honest work, not in fancy tips and insulators.

Sigma.

SOCIETY FOR PSYCHICAL RESEARCH.

[22187.]—What a funny letter 22152, p. 341, is! The idea of collecting negative evidence! Why a single positive evidence upon any subject outweighs millions of negations. Asking, too, of all the world, if they have ever had "hallucinations." Of course they have. I take it I am myself a singularly unsusceptible subject, and I often have the "impressions" inquired about. Occasionally, I have to move about my house in the dark, and at times I have the impression of some presence walking behind me, and even taking the liberty of putting an arm over my shoulder. It has been so strong at times that I have actually been reluctant to move in the dark, and have taken the trouble to get a light. When it comes to that pitch, I always consider a few drops of tincture of podophyllin desirable as an exorcism.

I know perfectly well why I have this impression. I have a distant remembrance of being twice frightened—once as a small child by some stupid servant in the dark. I was also subjected to an extreme nervous impression, when I was ten years of age, by my father and uncle, who ought to have known better. They took me without a word of warning into a strange house, and showed me, in his coffin, an uncle of whom I had been very fond, and had seen a few days before in good health, and made me kiss him. I have a very distinct remembrance of the following night, and how little peace there was in the house. I also understand perfectly well that this nervous impression will never be removed. It has had one singular effect which proves its cause. I have had all my life an intense repugnance to approaching a dead body—but only of a white person; a dead Hindoo or negro—and I have been a good deal among them—never sets up the same action, any more than any other animal.

Now, such incidents act on the majority of mankind, and they are subject to the effects, though few may be able to trace the actual cause, as I can. Of what conceivable consequence can any record of such transient nervous reactions be, except so far as to render doubtful other things which may be natural, and actual facts of an entirely different order? The attempt to collect them seems to me a ridiculous absurdity, which can only result in throwing contempt on the whole proceedings of the society.

The collection of *positive* evidence, and the careful testing of the conditions and trustworthiness of the testimony, would be legitimate and useful; but the other course is reducing the society to the level of a set of old charwomen chattering horrors over gin and tea. To those who have examined these subjects it is well known that only a few, and those of special constitution, are capable of receiving impressions worth examining, and there is quite work enough before any society proposing to carefully examine the reality of these cases, without taking up those which are certainly unreal.

Sigma.

Fish-Balls.—Prepare a pint of cold salt fish, after it is freshened and boiled, and chop it fine. For this have not quite a quart of fresh-boiled potatoes, mashed fine, a cupful of broken butter, and two even teaspoonfuls of made mustard, with salt to taste. Beat up an egg light and mix with these last-named ingredients, adding a little cream or sweet milk; then add the chopped fish, mixing all thoroughly together. Make into balls on a floured board, and fry in boiling lard like doughnuts. When uniformly browned, remove from the fat with a skimmer, drain, put on a hot dish and serve. Carefully prepared these fish-balls are exceedingly appetising and nutritious.

To Ebonise Wood.—1. One pound of logwood, three quarts of water; boil three hours. Apply hot. When dry, brush over with a hot solution of 2oz. sulphate of iron in 1 quart of water. Repeat if not black enough as soon as dry. It will be better if 1oz. of powdered gall nuts is added to the latter solution, though it is not strictly necessary. 2. Wash the wood with a boiling decoction of logwood three or four times, allowing it to dry between each application. Then wash it with a solution of acetate of iron, which is made by dissolving iron filings in vinegar. This stain is very black, and penetrates to a considerable depth in the wood, so that ordinary scratching or chipping does not show the original colour. 3. Mix a strong stain of copperas and logwood, to which add powdered nut galls. With this solution stain your wood, dry, rub down well, then use French polish made quite dark with indigo or finely-powdered stone-blue.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[52131.]—**Boiler Query.**—"Machina" asks whether the method I gave for testing a model boiler would not strain it severely. It would strain it, certainly; but if it is not capable of standing that strain, it would be quite unfitted to be used for working a model engine, because pressure is apt to rise very quickly in such boilers, and they are not always well made. For models, the factor of safety should, I think, always be 4, and the method of testing I gave is simple and trustworthy. If the boiler is to have a valve permanently loaded to 50lb., say, it ought to be tested to 200lb. by the expansion-of-water plan. It is practically impossible to calculate the bursting strain of such small boilers by the usual formulæ based on the strength of metals.—Essar.

[52147.]—**Chilled Roll Turning.**—In reply to "Mechanic," I wish to know how many revolutions per minute a roll 15in. diameter should make? what steel is used? and how tempered? what kind of emery wheel? how many revolutions it should go at? also the speed of lathe and the traverse? Any other information regarding the above I shall feel grateful for.—A. R. Wilkinson.

[52216.]—**Storage Battery.**—If "F. H." will refer to a goodly number of back Nos. he will find a variety of storage or secondary batteries described, and can take his choice. Kabath's is about the best he can make; but the simple Faure is the easiest: see p. 442, No. 851, and the volumes since XXXIII.—Nun. Dor.

[52225.]—**Raising Steam by Gas.**—I do not think gas can be made at a cost of 1¼d. per thousand cubic feet to give a profit; but there is not much doubt that it might be used in boiler furnaces with advantage. On p. 49, Vol. XXXIV., there is an article on the Gasifaction of Fuel, in which it is stated that Dr. Siemens had proposed to gasify the fuel used on board steamships, by adapting a modification of his regenerative furnace and using the fuel as what is called "producer gas." I believe the late Sir W. Siemens had intended to bring this matter prominently before the Society of Arts—not so much with the idea of preventing smoke, as with increasing the economy of the coal. There need be no smoke from those long chimneys which "K. M. G." mentions, and would not be if their owners knew what's what.—Nun. Dor.

[52229.]—**Induction Coil.**—Impossible to answer this query. The "Y. E." should try without the condenser.—E. L. M.

[52232.]—**Brass Polish in Liquid.**—Rather a peculiar title this. Why not dip the brass in dipping acid? If that won't do, try the effect of oxalic acid, and a bit of leather to bring up the gloss.—Nun. Dor.

[52234.]—**Electrical Measurements.**—I hope some one will kindly help with an answer to my query. If anyone has a dynamo that gives good results, will he kindly give the dimensions and weight of wires on armature and field magnets, and show how they were arrived at by calculating? One example would suffice to explain the system.—A Private in Electricity.

[52235.]—**Manganese Battery.**—"Herne Hill" must not expect to find the information in books, for many writers do not know, and when they do are too learned to trouble themselves with such details. The quantity required should be sufficient to make a saturated solution.—P. G. T.

[52239.]—**H.P. of Engine.**—This query is always cropping up. Why cannot the querist do the sum himself? The area of the piston is 3·14in., the length of stroke ⅓rd of a foot; the revolutions are 25, and the pressure of the steam 10lb. For convenience, multiply 25 × 10 = 250 × ⅓ = 83 × 3·14 = 260. That number divided by 33,000 would give the h.p.—in this case, 13-1650ths of one horse-power, or say 1-126th.—Essar.

[52240.]—**Stone Polishing.**—"Lapis" can find much information in back volumes; but if he wishes for a definite reply to his query, he must say more definitely what he means by stone, and also by the "saw."—Mason.

[52246.]—**Payne's Battery.**—The querist can scarcely expect an answer to his query. The proper way would be to purchase a cell, and see how it is made.—C. Ker.

[52255.]—**Parian Cement.**—I am not sure about this; but Parian, like Keene's cement, is made from plaster of Paris mixed with some solution, allowed to set, then recalcined and ground to powder. In the case of Keene's, the solution is, I think, a saturated one of alum; in the case of Parian cement, a solution of borax.—Nun. Dor.

[52256.]—**Brush Dynamo.**—I am unable to give the resistance of my machine either in A. or F.M.'s, not having a resistance galvanometer. The weight of wire on the four pole pieces is 40lb. The commutator is formed of six copper segments, each one being ⅙ of the circle, with a small air space between each one of 1/16 wide. Will he kindly say how I can increase the E.M.F. without rewinding, and I will try it and report result.—Williams.

[52281.]—**Whitening Silver.**—I think it better to explain to the "Plateman" or "Young Jeweller" the rationale of the process, and then he will be in a position to try for himself, with some idea of what he is doing. He had better leave cyanide alone until he is compelled to use it. I don't mean to say there is anything very objectionable about it, but it is poison, and should not be used when the work can be done better without. The principle of the process of whitening silver and colouring gold is to work out the alloy on the face of the article, and leave the outer surface pure metal. In the case of silver, provided it is not of too low a grade, heat the work to a good red, and boil in a mixture of sulphuric acid and water (one part to 40). For fine silver, once boiling will be enough; for inferior grades repeat the process until the desired whiteness is obtained. If the articles are very delicate, heat with a gas blowpipe until thoroughly hot all over. The advice to boil in sulphuric acid and water 1 to 8 may be correct, but if you did so at a factory you would get the sack. For plated articles, the cyanide is useful, but even then tartar and other things will do as well; but if the "silver" is of so low a quality that it ought with as much reason to be called copper, you must plate with a battery or by rubbing on a mixture of chloride of silver and cream of tartar equal parts, made into a paste with water and applied with a clean piece of good cork. Further information if required, but not privately.—Nun. Dor.

[52296.]—**Nearest Fixed Star.**—I am much obliged to those correspondents who have kindly answered my query. The journal (I call it a serial) may be, as Mr. Arthur Mee says, an "excellent" one, and "does not pretend to be scientific." That is just the mischief of it; it pretends to be a great deal more than scientific. I have had something more than a quarter of a century's experience in printing, and though I am tolerably conversant with the capabilities of printers to make muddles, I really should like to get a glimpse of how such a muddle could have been managed by the most ingenious compositor; for not only was "Alpha" omitted, but the whole thing was inverted and bungled besides. Mr. Mee is no doubt correct in saying the passage I quoted was a "slip"; but I submit that however excellent the medium through which they convey their teaching, "teachers" have no justification if they slip in that fashion.—Stellarius.

[52302.]—**The Cheapest Food.**—Thanks to those correspondents who have recommended me to read certain publications, including one on "How to Exist [no, Live] on 6d. a day." The information may be useful to some of my fellow-readers, if not to me; because I am getting quite an old reader of the "E.M.," and know that the pith of all those books can possibly contain is to be found in my back volumes. By the way, I saw a rather pertinent complaint the other day—in the *Echo*, I think. A working man went to the place where one of these wonderful books is issued, and after paying 11d. for his dinner, he didn't feel satisfied. He very reasonably asked "Where is the 6d. a day?" There is, unfortunately, a great deal of quackery in connection with food nowadays, as if some wonderful discovery had been made since the days when the Roman legions invaded Gaul. I have just been reading in an American paper a most instructive article by Dr. A. T. Cuzner, of New York, who has been making an elaborate analysis of certain flours and "foods" which are offered for the acceptance of the American people. I suppose most of your readers have heard of the celebrated Pillsbury Mills at Minneapolis, where they claim to have introduced the most perfect and scientific method of making flour. Well, Dr. Cuzner took as a standard white flour, a sample of Pillsbury "Best"; as a whole wheat flour a sample of the Franklin mills; and also a sample of the Health Food Co.'s cold blast gluten flour. This is what he found:—

	Bran. gr.	Gluten. gr.	Starch. gr.
Pillsbury Best	—	265	1,600
Franklin Mills Entire Wheat Flour	50	315	1,000
Health Food Co.'s..........	150	150	900

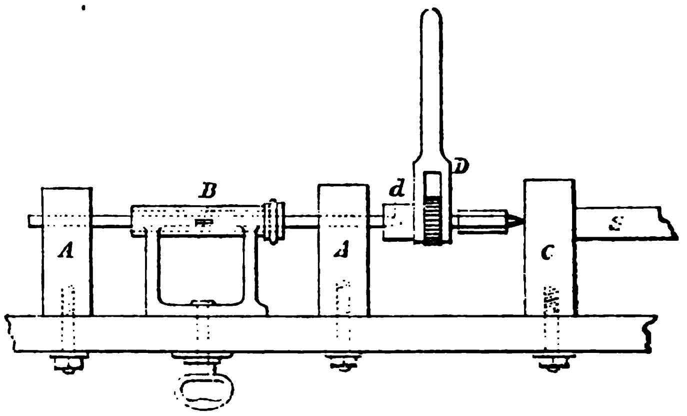
The microscope is not a complete test of the value of any flour, so Dr. Cuzner adopted the washing process as well, and the result was as above. The white flour contained a large per cent. of gluten and no bran residue; but as gluten cells stick to bran, the Franklin Mills' sample showed the highest amount of granular gluten ever found in fine flour—viz., 315gr., or allowing half the bran residue as gluten, 340gr. Here, however, is the curiosity: The

Health Food Co.'s sample contained actually a larger quantity of bran than is natural, indicating pretty clearly that bran had been added! It seems that I have been guilty of "flying in the face" of an answer (sic) sent to my query by Mr. Mee. I remember the "reply" sent by that gentleman, which I characterised as absurd, because, as an answer to my question for the "cheapest" food, it recommended something just double the price of Scotch oatmeal; but I am at a loss to know how I performed the gymnastic feat of flying in its face. It seems, too, that I have "very properly" admitted something—Mr. Mee being the judge of what is proper; also that I "wax so wroth" at some cereals which Mr. Mee has taken under his special protection, but which, strange to say, he does not describe in any definite manner. I should be very sorry indeed if I could believe it possible that the poorer inhabitants of the Principality cannot get the best Scotch oatmeal, or find a roller mill or a couple of stones to crush wheat, both of which, I believe, are "cereals," though Mr. Mee seems to hint that they are not. I spoke of them, because I know that they are the best and cheapest of the cereal foods, and as to the side-issue about dyspepsia, I can only say that doctors cannot provide a new stomach to order; but, if boiled crushed wheat cannot be digested, I am afraid that the stomach is hopelessly ruined. Dr. Edmunds, in his altogether excellent directions for making oatmeal porridge (Nos. 848 and 906), recommended a little heavy calcined magnesia to be taken where the porridge was not digested easily at first, and I presume that is a general remedy. If the inhabitants of Wales cannot afford a little roller mill, let them get two large flat stones, and just crush the wheat between them, not grind it. If Mr. Mee will condescend to inform us of the real character of his peculiar cereals, we may be in a position to judge whether they are such wonderful things as he seems to think; but I would beg of him to remember that my question has reference to food value, not to his or anybody else's personal tastes.—S. R.

[52383.]—**Crumpets.**—Take 2lb. of flour, make into dough with warm milk and water, adding a little salt, three eggs, well beaten, and three teaspoonfuls of yeast mixed to the consistence of thick batter. Stand before the fire to rise, pour into greased tins, and bake slowly until of a light yellow. If "S. B." wants a commercial recipe, he will, of course, omit the eggs, and I think he would find it more convenient to use baking powder than yeast; but the addition of even one egg to the quantity of flour above given will vastly improve the plain article.—B. M.

[52387.]—**Bending Brass.**—If "Jim" can make his brass soft by heating it to a red, he will be able to easily bend it, by getting some one to make him a moulding of the desired form. Thus the mould might be carved out of beech, and a block to fit other side. It would be advisable to have the under block a good length; the other may be any convenient size, and be hammered with a mallet. Brass, after being heated red, becomes very soft, but the hammering makes it hard again. Hence, if "Jim" has many to do, it would be advisable to have his "form" cast in iron longer than his plates; or get a proper set of rolls made at once. Two sets of shaping rolls and one in the centre, set a little out of line, will keep his plates quite straight, and he can bend as fast as he can get them through the machine.—J. T.

[52411.]—**Cheap Lathe.**—Although I have never adopted the following method, an acquaintance of mine made use of it with successful results. Having arrived at that stage where the headstocks are fitted to the bed, we proceed in this way. Get two blocks of hard wood, A A, and fasten down on the bed, with the article to be bored, say the poppet, between them. In these blocks, in a position corresponding exactly with the poppet centre, bore two holes with a centre-bit to take a cutter, or boring bar, fitting closely, but not so tight that it will not turn round when slight torsional leverage is imparted to it. Let this bar be ⅝in. or ¾in. in diam. (as large as the bore of the poppet will permit, for the sake of rigidity). A slot cut through at B will receive the boring tool. At the right-hand end, *d*, the bar is filed square, like the shank of a drill, in order to fit into a ratchet brace, D. Behind the ratchet brace, a third block of wood, C, is fixed; but this block, instead of being bored like the others, has a piece of metal plate screwed upon its face, with a countersunk hole corresponding in position with the poppet centres, which hole receives the point of the ratchet brace, and becomes its point of resistance. The strut S is carried from the back of the block C, to any convenient place of support—a wall, if available. To bore the hole, work the ratchet lever, tightening it at every third or fourth turn. When run out, carry the back block, C, forward, two or three such removes being sufficient. The sketch shows the cutter half-way through. It is rather a slow process, but one doesn't mind a little time in amateur work. In boring the headstock, the ¾in. hole for the back centre must be drilled first; then 2in. or 3in. of the end of the cutter bar turned down to slide in it, while the cutter bores through the mandrel brasses. J. H.



[52435.]—**Extraordinary Phenomenon.**—I will call it "achromatopsy" next time, and then I shan't be accused of "poking fun" (p. 349), because critics will dive into their books to discover the meaning of the term. "H. O'B." appears to think that the "colour-blind" see everything as either black or white.—Nun. Dor.

[52460.]—**Casting Lead.**—If the castings are light, and a number are required, I have tried plaster of Paris, and find it works well. See that it is properly dried, and if the mould is so that a little blacklead can be rubbed on the face with a piece of rag, the casting will look much better. Don't have the lead too hot, or it will cause the plaster to crack. With care, several hundred castings can be made off one mould.—Williams.

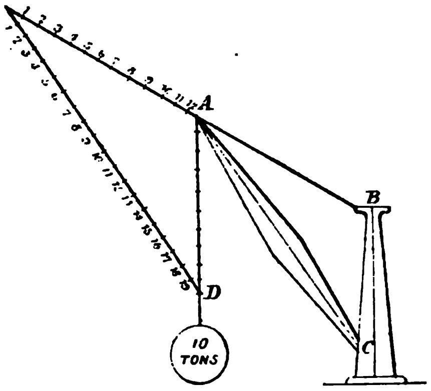
[52465.]—**Belt Working off Pulley.**—Your belt works off the pulley because your shafts are not parallel. Take off the flanges and adjust the shafts truly parallel. The belt will run off the pulley on the side at which the shafts are furthest apart. —R. R. N.

[52465.]—**Belt Working off Pulley.**—If "A. B. C." will have the face of pulley well rounded similar to a barrel, the belt will not work off unless it is stretched more on one side than another. See that the pulleys are in a straight line. —Williams.

[52466.]—**Cross Belts.**—Cotton belts are not suitable for cross running: the edges wear very fast. Try a good leather one, and order from the makers to run crossed; and if it is a double one, have it copper stitched. In working, castor-oil the edges.—Williams.

[52466.]—**Cross Belts.**—There is always more or less attrition in a crossed belt, and nothing but leather is suitable for this purpose. If a 4½in. belt gives enough power, a leather one would last a long time, though in the case you have given the attrition will always be considerable, and power is absorbed thereby. If circumstances admit of it, an open belt with the working side at the bottom (the shafts being horizontal) would be far preferable. This arrangement causes the slack side of the belt by its own weight to embrace the pulley, and admits the use of a comparatively slack belt.— R. R. N.

[52474.]—**Strain on Jib-Chain.**—If by "jib-chain" "Radnor" means the tie-bar (or chain) A B, then let him make A B = length of tie-bar;

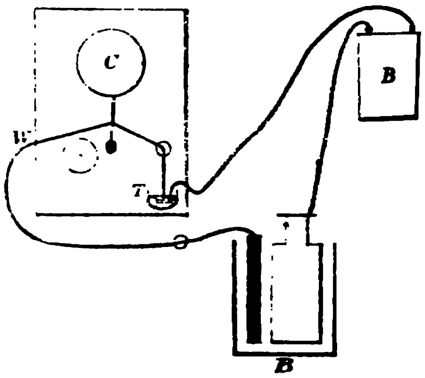


A C = length of jib; B C height of post. Draw A D vertical equals W = 10 tons, or 10 divisions of any scale. From D draw D E parallel to the jib until it cuts the line A B produced to E. The strains may be measured off by means of the scale as follows:—Strain on tie-bar = A E = 12¼, strain on jib = E D = 19½ tons.—J. S. B.

[52472.]—**Sailing.**—No glazing or smoothing of the sails of a ship would make any appreciable difference to its speed. The friction between particles of the air (their resistance to motion over or against each other I mean), is less than that between the same particles and the smoothest surface that could be produced on the sails. The result, therefore, whether the sails are smooth or comparatively rough, is the same: a film of air clings to the fabric, becoming, for the time as it were, a part of the sail, and the friction is between particles of air only a little distance away from the sail, and not between the surface of the sail itself and the air.—W. Wyatt.

[52479.]—**Electric Clock.**—Having read "Kiko's" reply to this query, I am much interested with it. I have made an arrangement so that my clock rings an electric bell for ten minutes: but should like if "Kiko" would send a sketch of his arrangement. I am sure he would oblige other readers besides.—A Rechabite.

[52479.]—**Electric Clock.**—If "Nomen" is satisfied to have his bell strike in the interval between each stroke of his clock, he can do so in the following manner:—One wire from the battery is to be connected direct with the bell. The other wire is to be connected with the hammer of the clock in such a manner that when the hammer rises it will drop the end of the wire into a small trough of mercury, or upon a small plate of clean copper, where the break in the circuit is made. The diagram will explain itself. C is the clock, B the bell, and B′ the battery, and T is the trough of mercury. The wire between the hammer and the trough passes through one or two small rings, which serve to guide it, and is slightly weighted near its end, in order to insure its dipping into the mercury when the clock hammer rises. The wire between the point W and the hammer should be twisted into a spiral, in order to allow the hammer to rise freely. I can testify to the working of this plan, as I have done it myself exactly as I have described it. The best battery for this work is the Leclanché.— W. B. M.



[52482.]—**Electric Bell.**—I have a similar bell hung in my bedroom, which, like the querist's, refused at times to work. On watching it closely, I found that the contact-spring stuck to the pillar-screw; therefore, the current was not broken at all, so I bent the hammer back away from the bell very slightly indeed, so that it would have to go farther to strike the bell, and it has not failed to work since.—F. B., Moseley.

[52484.]—**Dark Slides.**—Get a piece of mahogany, 2ft. long by ¾in. deep and 5/16in. wide [illegible] measurements. With circular saw, run ⅛in. width three grooves—one in the probable that a metal, otherwise so permanent, would lose its durability when so thin."—S. R.

[52530.]—**Engine v. Man Power.**—One man's-power is usually reckoned ⅙th of a horse-power, or = 5,500ft. lb. Therefore, a "two man-power" gas engine should give out 11,000ft. lb. But you will find it better and more economical to have a ½-h.p. gas engine, as the smaller sizes are not so reliable except when new and in first-rate condition.—Labor Omnia Vincit.

[52535.]—**Electro-Magnets.**—An article of mine is in type on this subject, and will be followed by another, in which I will see if I can meet the querist's wants without merely working out a particular case, which is a thing I never care to undertake, except as an example.—Sigma.

[52540.]—**Incrustations in Boilers.**—Your correspondent "Ferro" should visit the locomotive sheds of the London and North-Western Railway Company in London or Liverpool, or one of the many large manufacturing establishments to which the patentee of the Porter-Clark process would be willing to refer him, for a view of the "practical working" he desires information upon. The leading feature of the process is the precipitation of the carbonate of lime of the hardwater by the use of caustic lime in solution, the caustic lime becoming carbonate and being precipitated also. With soda ash the soda would remain in solution. Moreover, the price of the soda is ten times as great as that of the lime. Agitators are employed in the Porter-Clark process, which is carried out in closed vessels and pressure filters, whereby large quantities of water are treated, by continuous working, within a small space, and, being under pressure, the softened and filtered water at Camden re-ascends without pumping to the service tank. The larger the quantity treated, the smaller the cost per 1,000 gallons.—C. C.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

51997.	Induction Coil, p. 160.
52001.	Wads, 160.
52032.	Leather Stains, 161.
52035.	Copying Tracings, 161.
52039.	Scagliola, 161.
52042.	Faulty Telescope, 161.
52049.	Railway Gate, 161.
52050.	Rolling Stock, 161.
52052.	Spectrum, Temperature of, 161.
52213.	Electric Launches, p. 250.
52214.	Boring Tools, 250.
52222.	Chemistry and Dyeing, 250.
52224.	Lantern Microscope, 250.
52241.	Defective Ejector, 251.
52248.	Trustee, 251.

Natural Gas for Manufacturing in Western Pennsylvania.—For nearly ten years past natural gas has been utilised for manufacturing and lighting purposes in only a few instances, although several abundantly-yielding wells, and a large territory from which it was known gas could be drawn, have been familiar topics among the manufacturers of Western Pennsylvania. Recently, however, attempts are being made to utilise this natural gas on a large scale by the iron and steel and glass manufacturers. All the window glass manufacturers of the Southside, Pittsburgh, Pa., have closed a contract with the Niagara Gas Company to supply their factories with natural gas. The company is now operating in Washington County, and representatives of each factory have been negotiating there for the drilling of gas wells and laying of pipe. The manufacturers have leased about twenty thousand acres of land in that county, in the neighbourhood of the McGugin well, the largest natural gas well in the world. They expect to arrange for the drilling of several wells on their territory, the work to begin at once. The Edgar Thomson Bessemer steel works, at Braddock, Pa., have also been completing arrangements to run their whole plant, in which 100 boilers are in use, by natural gas to be obtained from a gas well at Murraysville.

Raised Doughnuts.—Mix together one quart of flour, two cups of sugar, half a teaspoonful of grated nutmeg, a pinch of allspice, a teaspoonful of cinnamon and a teaspoonful of salt. Cream half a cup of butter and put in, stir half a cup of good strong yeast with a pint of warm sweet milk, and put in with the rest. Of these make a soft dough and let it rise over night. Next day stir in three eggs beaten separately, and a pint of flour with a half teaspoonful of soda mixed with it. Let this dough rise till it is light, then fry in hot fat.

QUERIES.

[52548.]—**Wharf Crane.**—Would any of your readers inform me what measurements I should take of a wharf crane to enable me to calculate its lifting capacity? Also, could any one recommend a good simple work going fully into this and similar matters?—Vaga.

[52549.]—**Unfermented Bread.**—I have for some time made the unfermented bread described by "J. F. E." and "A Physician" in the E. Mechanic two or three years ago, but lately find that the bread has an unpleasant smell. Can any of your correspondents kindly explain this? I much like the unfermented bread, and should regret having to give it up because of this smell.—C. E. L.

[52550.]—**Power of Engines.**—Will some readers tell me what power my engines are? I have a pair connected together. The cylinders are 18in. diam., 4ft. stroke, cut off steam at two-thirds of the stroke, and work at a pressure of steam in the boiler of 45lb.—Engineman.

[52551.]—**Small Steel Balls.**—Could any of our readers give particulars of tools, &c., for making?—R. G.

[52552.]—**Steel Reeds.**—Purposing to make four sets of steel reeds for my harmonium, the body of which I have just finished, I should feel obliged for information as to length and breadth of slit in brass frames for tongues for a 4, 8, 16 and 32ft. set of five octaves each, and what thickness should I make the brass frames for the different sets? What effect has the thickness of the frame on the tone of the tongue?—Brazier.

[52553.]—**Photographic.**—Will some subscriber kindly answer the following queries?—(1) We are told that the rapidity of a lens is equal to $\left(\frac{f}{a}\right)^2$ (f being focal length, a aperture). May this rule be applied equally to doublets and single-view lenses? I have seen the rule applied to both, but have also heard it stated that a photo. taken with one combination of a rapid rectilinear requires only twice the exposure (with the same aperture) that the whole lens would require. One of these statements is obviously incorrect. (2) Can the back combination of a portable symmetrical lens be used alone as a single-view lens? (3) Would a pair of portable symmetrical lenses answer well for general stereo work, and would 4in. or 6in. focal length be the most suitable?—Amateur.

[52554.]—**Travel of Gauge.**—What travel should a gauge (or inside calipers) have in a round hole from 1in. to 100in., to secure a good fit?—A. R. Wilkinson.

[52555.]—**Piano Keys.**—Would Mr. Davies oblige by informing me the best and handiest way to prevent keys from sticking down? The keys appear to have warped or twisted at the hopper end of key, and rub one against another. Surely good keys should not do so? The keys appear to be made of a very light wood to feel at; rather like colour of pitch pine. What kind of wood should they be made of?—Ivory.

[52556.]—**Geometrical Drawing.**—Can any of "ours" mention the title of the textbook or books used by students with a view to passing the examination in this subject of the Science and Art Department? Is "Payne's Projection" sufficient for the solid geometry in all three stages?—Stud.Inst.C.E.

[52557.]—**Ornamental Steelwork.**—Would any one kindly explain the manner French mechanics ornament bright steelwork, say the plates of locks, &c., with geometrical designs which are more or less elaborate, according to the quality of the articles ornamented (moirés)?—T. W. W.

[52558.]—**Food for Bees.**—Will some of the many readers of the "E. M." kindly give me a good recipe for making candy for bees? What sort of sugar should I use, what proportion of water, and should I use any cream of tartar in it? I have tried making it several times; but it gets quite grainy, something like the sugar being boiled, and if boiled less it is too soft and sticky. I can't make it like barley sugar—hard, but not grainy. The best way I succeed in doing it, though not well, is by boiling to syrup first, and then boil it until all the water gets evaporated. If it gets slightly burnt is it injurious to the bees? I was told putting lemon-juice in it makes it hard. Is it so?—O.

[52559.]—**Extracting Aniline Colours.**—Is there any acid (or other substance) that will extract aniline colours from papers, &c.?—Chemicus.

[52560.]—**Springs.**—As I have been unable to get any information respecting the music-turning machines referred to, will "S. M." kindly say if they are costly articles? I presume they can be obtained through music-sellers? With a little alteration one of them would perhaps suit my purpose.—Inexperienced.

[52561.]—**Waterproof.**—I have recently seen in the shops a new waterproof overcloak with a peculiar white glossy surface resembling plush. It is called the electric cloak. I should be very glad if any of your numerous readers could inform me the process by which this surface is obtained? From a cursory glance it appears to be from a surcharge of sulphur; but in this I may be wrong.—James T. Vincent.

[52562.]—**Terracotta.**—I have a terracotta statue which is broken at base. The fragments will not piece. Can any reader inform me how to make a new one—and how to get the desired colour? I have no knowledge how to mould one, and would be thankful for information.—Ercildoune.

[52563.]—**Harmonium.**—As Mr. Fryer seems to have overlooked my query on p. 269 (reply 52125), may I try to catch his eye through the query column, and ask him what size he would make the holes leading from the windtrunks and the reservoir to suit valves of the sizes given by him on p. 248? Will he also explain how he fits the escapements to those valves—that is if I am not asking him to disclose trade secrets?—Fliegen.

[52564.]—**Model Yacht.**—Can any of our friends give good lines for a model yacht (schooner preferred), and also say if pine, oak, or mahogany "planks" are the easiest to bend and work? The model is to be about 4ft. long, and to be built, as there is such a difficulty in getting suitable log.—V. P. Y. C.

[52565.]—**Spectroscope.**—It seems to me that amateurs might easily make a pocket spectroscope if some one would give similarly plain directions as were given by "Aldebaran" for telescopes. I mean an instrument something like the star spectroscope or the rainband spectroscope.—Latheman.

[52566.]—**Plaster Casts.**—Will any one tell me how to take plaster casts from clay models where there is a good deal of undercut work? The work I mean is done for the students of art classes, who now have to send in all their model work in the shape of plaster casts. The workman moulds up the clay to the desired form, and then the caster builds a frame round it, and pours over it the plaster—working the latter well down. When the plaster is dry, the clay is picked out a piece at a time, and as the work is thus destroyed it is of importance to make sure of getting the plaster mould all right. When that is obtained a plaster cast is taken from that. Now will some one help us in this, and give us such instruction as may enable us to take our own casts?—Seven Students of an Art School.

[52567.]—**Packing Screws.**—Could any of "ours" kindly inform querist if they are aware of any machine for making screws for the removal of old packing from stuffing boxes, &c.? If so, give the name of the maker; if the machine is a patent, and the probable cost of the screws. Also, is there any particular name given to such screws?—Johnstone.

[52568.]—**Oxidising Silver.**—I have tried the two methods recommended on p. 311, but neither makes the silver black enough, and it will not stand the scratch-brush. I want a jet black.—E. H.

[52569.]—**Steam Jacket.**—Having an engine cylinder steam jacketted, supplied with steam from steam chest through a 1in. pipe, and a stop tap in pipe to shut steam off, underneath cylinder is another pipe leading to a steam trap: will the trap keep the steam back, and let any water pass which may be in jacket? Also, is it necessary to keep the tap always open when the engine is at work? I have been told to close it after the engine has started. If so, I cannot see the use of the steam trap. Perhaps "L. O. V." or "Firer, Dewsbury," will explain the use of the steam trap to me, and oblige.—Cold Chisel.

[52570.]—**Hair.**—If any one can kindly tell me how to destroy the roots of superfluous hair, I should be much obliged.—X. X.

[52571.]—**Carmine.**—Can any of our readers who have a practical knowledge of the subject tell me how much pure ammonia it will take to dissolve 1oz. of chemically pure carmine?—F. H.

[52572.]—**Sunspot.**—Will any reader give me an approximate date for the large sunspot which not long ago was visible to the naked eye? From cloudy weather and other causes I regret to say that I missed it.—T. W. Webb.

[52573.]—**Dimensions of Boiler Plates.**—Will Mr. S. Nicholls, or some other reader, give the rule for finding the length of plates for dished and flanged ends of boilers?—Boiler.

[52574.]—**Torpedo Engine.**—Can any reader kindly furnish me with the size and power of engine used in propelling the Whitehead torpedo?—Gun Cotton.

[52575.]—**Grease.**—Will some reader of ours be good enough to give me a recipe for the manufacture of hot and cold neck grease suitable for use in mill and forge work, and the method of preparing same?—Grease.

[52576.]—**Boat Cloths.**—Please give me the correct size the deck cloth, cabin cloth, and wings should be for an ordinary canal boat, with an outline plan showing the exact position of the various holes for tying on. Also what length should the ropes be that are spliced in these holes?—Tarpaulin.

[52577.]—**Organette.**—I wish to make one of these instruments myself. Will any one kindly tell me a good selection of reeds (there are only 14 in the common instruments), and give any directions for cutting the music papers? How are the spaces marked off so as to find the exact position to give correct time?—T. J. P.

Making Black Leather.—It is not every sort of leather that will take the black colour equally well, says *Gerberzeitung*, the oak tanned taking the colour best, pine and birch bark leather taking it the worst. If the leather does not take the colour well, it should receive some previous preparation. A solution of the carbonate of soda is generally used for this purpose; although the use of caustic soda or ammonia is less injurious to the leather. The leather is then washed off with clean water and the ground colour laid on thinly with a brush and rubbed in until it is all taken up. A good preparation for this purpose is obtained by boiling Campeachy wood for half an hour in twice its weight of water, adding a sixth part of fustic to give a more intense black, pouring off the decoction, and boiling the wood in clean water for two hours. Some potash may be added to the second decoction to aid in the extraction. The dye is poured off clear or filtered and preserved in a closed vessel. The black colour is prepared by treating old iron with a decoction of barley, sour beer, or sweet tan liquor. It is left for a few days, the dirt removed from the surface, and the clear liquid drawn off. This black colour must not be applied until the ground colour is completely absorbed, or the leather will be sooty. After the black dye has been rubbed in with a brush, it will have a finer appearance if another light coat of Campeachy solution is applied, and then rinsed with water until it runs off clear.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 4, 1884.

THE PROGRESS OF ASTRONOMY IN 1883.

IF the year which has just drawn to a close can scarcely be regarded, in an astronomical point of view, as a very eventful one, yet it has seen an amount of good and enduring work done, and results achieved which may fairly entitle it to be regarded as marking a yet further advance in astronomical science.

The chief celestial phenomenon of the year has undoubtedly been the Total Eclipse of the Sun on May 6th, remarkable, inter alia, for the great length of totality. The sun, as probably a large proportion of our readers are aware, was hidden for nearly 6 minutes, and this is a duration which will be only once exceeded during the remainder of the century—viz., on Aug. 29th, 1886, when, in West Africa, the sun will be covered by the dark disc of the moon for 6m. 21s. The Eclipse observed in the May of the previous year (1882) lasted less than two minutes. The recent Eclipse was observed from Caroline Island in the South Pacific by observers sent out by Austria, France, Italy, the United States, and this country. The Corona was observed to extend visibly to some two diameters of the sun—i.e., to a height of 1,732,000 miles above his surface. The French photographs show that its real extension was greater than that observable either to the naked eye or in the telescope. Dr. Hastings found the line D of sodium dark in the Corona—a pretty conclusive proof of its consisting of matter which reflects sunlight (of which M. Janssen obtained independent evidence), and one affording a strong corroboration of the truth of the theory of the meteoric character of the outer part of the Corona. Moreover, in the largest of the Coronal streamers, M. Tacchini detected the spectral bands so familiar in the spectra of some of the recent comets; and there are but few people now, and assuredly no astronomers, who are ignorant of the very intimate connection which exists between comets and meteors. The form of the Corona remained absolutely unchanged during totality. MM. Palisa and Trouvelot occupied themselves in making a diligent search for the entirely mythical planet Vulcan. M. Palisa was supplied by Prof. Holden with a chart of that region of the sky in which the sun was situated, and while he succeeded in recognising nine stars in the Bonn "Durchmusterung," could not see the slightest trace of any fifth mag. star unmarked in his chart, between R.A. 2h. 52m. 14s. to 19° N., and R.A. 3h. 40m. 16s. to 22° N. In sweeping with his instrument, M. Trouvelot, while easily recognising 41 and ε Arietis, did come across a reddish star, which he was, for some time, disposed to imagine might be the intra-Mercurial planet. Professor Holden has since shown that this was simply α Arietis. We can scarcely conceive, after this, that any future observers of total solar eclipses will waste a single instant of their precious time in looking for Vulcan, whose non-existence may now be considered to be irrefragably established. The English observers were successful in getting photographs of the bright line spectrum which appears at the instant before and after totality. The red prominences, which have formed such a marked feature in former eclipses, were, on this occasion, conspicuous by their absence. Much coronal structure is shown in the French photographs.

Two Comets have been discovered during 1883. The first one on February 23, by Messrs. Brooks and Swift, in America; the second by Brooks alone on Sept. 2nd, which has since been identified with the one discovered by Pons on July 20th, 1812. The latter is visible as we write. The spectrum of the Brooks-Swift Comet, as observed by Dr. Von Konkoly, at O'Gyalla in Hungary, consisted of three bright lines superposed upon a very faint continuous spectrum. There can be little or no doubt that these lines belonged to hydrocarbon. This observation has since been repeated at the Royal Observatory at Greenwich.

Reverting to the Sun, we may recall the numerous and striking indications of activity afforded by the splendid spots and groups of spots which have appeared; some of them having been visible to the naked eye. Notably was there one at the beginning of April, covering an area of upwards of 484,000,000 square miles on the solar surface. All observers of solar prominences with the spectroscope are familiar with the line D_3 immediately following D_2, which, as every one knows, is one of the lines of sodium. So far, this line D_3 had never been identified with that of any known terrestrial object, and the unknown substance to which it is referable was called, for want of a better name, "Helium." During the past year, however, Professor Palmieri has discovered this line in the spectrum of certain Vesuvian lava; so that at last it would appear that we are in the way of identifying this hitherto unknown element in the solar atmosphere. We mentioned last year (Vol. XXXVI. p. 396), the invention by our greatest living English spectroscopist, Dr. Huggins, of a method of photographing the Corona of the uneclipsed sun. Grave doubts, however, have since been thrown on the validity of his mode of proceeding: in fact, it is now suspected that the pseudo-Coronal structure visible in his negatives may have its origin in reflection from the dark backing of his photographic plates; such backing being painted on in streaks with a brush.

In connection with Celestial Photography, nothing has hitherto ever been effected to equal the superb photograph of the great nebula in Orion obtained by Mr. Common, with his 3ft. reflector, on January 30th, 1883. This marks a very distinct advance, indeed, in the photographic reproduction of celestial objects. Dr. Huggins has also successfully photographed the spectrum of this nebula with an 18in. reflector.

Three new Minor Planets have been added to the already terribly overgrown list of these useless and uninteresting bodies; the known number of which now amounts to 234. This exaggerated meteor-ring (for it is very little better) between Mars and Jupiter is now becoming emphatically a nuisance, as much valuable time is wasted in certain observatories in efforts to identify and follow objects which are wholly unworthy of the labour bestowed on them. In the cases of the few which approach nearest to the earth, Juno, Flora, Victoria, Sappho, and one or two others, it is needless to say that they can scarcely be too sedulously observed, affording, as they do, one of the most promising and accurate methods of determining the Solar Parallax. As regards, though, by far the larger proportions of these bodies, we are indebted to German astronomers for following them at all. They might very well be let alone altogether.

In Physical Astronomy, one of the most important essays of the past year was made by Mr. E. J. Stone, F.R.S., the Radcliffe observer at Oxford, and P.R.A.S., in his investigation into the alleged retardation in the rate of the Earth's rotation (in other words, the lengthening of the terrestrial day) in connection with the amount of lunar acceleration, supposed to be otherwise unaccounted for. In his very remarkable paper, first read before the Royal Society on April 12th, of which he gave a *vivâ voce précis* on the succeeding evening at the Royal Astronomical Society, he advances the novel and somewhat startling hypothesis, that the strange discordance between the theoretical value of the secular acceleration of the moon's mean motion, as determined by Prof. Adams, and that required to reconcile Hansen's tables with the records of ancient eclipses, really had its origin in the fact of our having changed our unit of time! The Radcliffe observer contends that no proper distinction has been drawn between the longitude of the mean sun and the mean longitude of the sun, and that when consistent units are adopted, the observed acceleration of the Moon's mean motion agrees with that required by theory. Mr. Stone's paper was subsequently published in an extended form in the R.A.S. *Monthly Notices* for May. If we accept Mr. Stone's deductions, it follows that the whole question of the supposed increase in the length of the day must still be considered as sub judice, and without any practical or observable proof whatever.

M. Nyren has re-determined the Constant of Aberration, from many years' observations at Pulkowa: he finds it to be 20·492″. M. Folie, of Liége, has discovered what he believes to be observable proof of diurnal Nutation, whence he concludes that the earth must consist of a fluid nucleus surrounded by a crust scarcely exceeding 180 miles in thickness. A short account of M. Folie's investigation was given by one of our correspondents on p. 300.

A re-determination of the Mass of the planet Saturn has been made by Professor Asaph Hall, from observations of his satellite Iapetus during the years 1875, 1876, and 1877. Calling the sun's mass unity, Professor Hall finds that of Saturn to be $\frac{1}{3482\cdot2}$.

Although the investigations of Professor Asaph Hall on the Parallax of α Lyræ and 61 Cygni terminated early in the autumn of 1882, his results did not reach this country until 1883, so that we may fairly include them in our review of work pertaining to the latter year. The entire research is of the most exhaustive character, and is founded on a long series of observations of the highest class, commencing in the year 1862. As final results, Professor Hall finds the parallax of Vega to be 0·1797″ ± 0·005612″; so that light must occupy 18·11 Julian years in passing from this star to our sun. The parallax of 61 Cygni he determines to be 0·4783″ ± 0·01381″, indicating a distance which light takes 6·803 Julian years to traverse.

Our remarks with reference to the date of the appearance in England of Professor Asaph Hall's work apply, mutatis mutandis, to the perfectly masterly monograph of "The Central Parts of the Nebula of Orion," by Professor Edward Holden, recently issued as an appendix to the "Washington Observations" for 1878. No one can henceforward attempt the study of the marvellous region surrounding θ Orionis without the aid of Professor Holden's exhaustive account of all that has, so far, been observed and recorded of it.

A preliminary account has been given by Her Majesty's Astronomer at the Cape of Good Hope, Dr. Gill, of his telegraphic determination of the longitude of the Royal Observatory there. It is a most noteworthy fact that this determination is within a single quarter of a second of that made by Henderson from lunar observations about 1833.

M. Stephan continues his Catalogues of Nebulæ observed at Marseilles. 45 new ones appear in that for 1883.

A "monumentum ære perennius" has been erected by Professor Peters, of Clinton, U.S., in the shape of 20 charts, containing from 2,500 to 3,500 stars each, down to the 11th mag. of Bessel's scale, comprised in a belt extending 30° on each side of the equator. Each map covers 20min. in R.A., and 5° in declination, and is on a uniform equal surface projection on a scale of 2·36 inches to 1°. These maps are photolithographed from Professor Peters' original one.

Stellar Photometry is steadily pursued at Oxford, and at Harvard College Observatory in the United States. A very simple and ingenious form of photometer for the measuring of variable stars has been designed by the Rev. T. E. Espin, observer to that very excellent and practical little association the Liverpool Astronomical Society. A description of this instrument from Mr. Espin's own pen appeared on p. 384 of our last volume.

The Great Red Spot on Jupiter, which has formed so marked and persistent a feature on the face of the planet since the year 1879, is now fading perceptibly; in fact, it is only visible in instruments of considerable size and power.

The Observatories of Copenhagen, Greenwich, Kiel, Milan, Paris, Pulkowa, Utrecht, and Vienna, have fixed upon Kiel as a centre for the transmission of Astronomical telegrams. An annual subscription of £5 entitles any Observatory to receive telegraphic information of every fresh astronomical discovery. During the past year, Mr. G. H. Darwin has been appointed Plumian Professor of Astronomy at Cambridge; and Dr. Doberck has been transferred from Dunsink to the Directorate of the Observatory at Hong Kong. M. Houzeau has resigned the Direction of the Royal Observatory at Brussels, causing, it is to be feared, [illegible] our own National Observatory sustained by the retirement of Sir George Airy.

The [illegible] glass for the equatorial of the Lick Observatory approaches completion, and the great French refractor of [illegible] feet in focal length, which is to be [illegible] the Observatory in Paris. [illegible]

THE NEW PATENT RULES.

[illegible]

working of the new Act would mainly depend. It is too early to say definitely that the new rules will spoil the Act; but it is too clear that red tape has had the usual amount of influence in framing them. As we announced last week, no applications would be received if they bore an earlier date than Jan. 1, 1884; but it is doubtful whether any one had authority to make such an order, which practically precludes inventors from entering their specifications on the first day of the new Act, because it is next to impossible for country residents to get the declaration sworn and the other documents into the office on the same day. Communications from abroad are not abolished, for a special form is provided in the schedules (A1), by which an agent or any other person can obtain a patent for an invention communicated to him from abroad; and although there is nothing about it in the Act, Rule 31 imposes on the applicant the duty of furnishing the Comptroller with a drawing illustrating the features of novelty constituting his invention, and a concise explanatory statement, in addition to the specification—the object being evidently to save the office the cost of preparing abridgments, and to obtain ready-made copy for the new illustrated journal which the Board of Trade will issue. The third clause of the 45th Section of the Act, which distinctly states that as regards the amount and time of payment of fees, the Act shall extend to all patents granted before its commencement, is put on one side by Rule 43, which provides that the fees payable before the expiration of the eighth year according to the Act shall be payable before the end of the seventh in the case of patents granted prior to 1884. It would seem, then, that all existing patents, and all those to be granted which will bear dates anterior to Jan. 1, 1884, the rule is "as you were"; for the Act having been overridden so far as section 45 is concerned, it would seem that even the new method of paying the £50 and the £100 by instalments will not apply to patents bearing dates prior to 1884. It appears to be tacitly admitted that section 45 in the new Act, so far as [illegible] is a mistake, [illegible]

[illegible]

pointed to receive such declarations; and all other documents or communications between the Comptroller and the applicant may be signed or made by an agent duly authorised to the satisfaction of the Comptroller. The application should be made on the printed form provided for the purpose, and contain an address to which notices, &c., may be sent; but if a printed form cannot be obtained the application should be written in large and legible characters in the English language upon one side of strong wide-ruled paper 13in. by 8in., leaving a margin of 2in. on the left-hand side. That applies to all documents and copies of documents sent to or left at the Patent Office. The applicant having procured the form and stamp (£1), will fill it up in accordance with the directions, giving merely the title of the invention (which, however, must clearly indicate its nature), and get it signed by the magistrate before whom the declaration is made. (The fee is usually 1s.) This document must then be forwarded to the Patent Office, accompanied either by a provisional or a complete specification in duplicate. No stamp is required on the provisional, but £3 is payable on the complete specification, one copy of which must have the stamp affixed in the regulation manner. It is advisable to purchase these forms, which are sold at a cheap rate; but where it is impossible to do so, or where the form is not large enough to contain the whole of the description, the continuation must be written on wide-ruled foolscap with a margin as above mentioned. When drawings are necessary, they must be made on half-sheets or sheets of imperial drawing-paper, and be within a border line of 19in. by 12in. or 27in. by 19in. with a margin of half an inch all round. A copy of these drawings must also accompany them; but in this case they may be on ruled imperial drawing paper, or upon Bristol board; have the same dimensions as above, and be prepared according to the special directions following. The border should be one fine line only, but all lines must be absolutely black, of the best quality Indian ink, and care must be taken to secure the same strength of ink throughout, that is, absolutely black. Shading [illegible] e a drawing with every specification, htsmen will be sorely puzzled! As a the applicant will not send in a com- specification with his application, but est content with a provisional, and g prepared the documents required, y either post them or take them to the t Office. If they are posted, they be deemed to have been left at the t Office at the time when the letter ining the same would be delivered in dinary course of post. "In proving service or sending, it shall be sufficient ve that the letter was properly ad- d and put into the post." Suppose, ver, the packet is lost in transmission gh the post (such losses have occurred), will the inventor prove the posting, at the same time, show that his docu- s contained a description of an invention somebody else has entered, it may ust after the time at which the lost t should have been received in the inary course of post." We have nothing against the Post; it is one of the few rnment departments which is really d well; but an inventor in making ation for a patent should take especial that his "papers" reach the Patent as soon as he is ready to deposit them. ocuments being safely deposited at the t Office, the application will be re- to an examiner, who will report to mptroller as to the sufficiency of the ption, &c., of the invention contained provisional specification. Should the be unfavourable, the Comptroller may to accept the application, or may the amendment of the specification; must give ten days', or such longer as he may think fit of the time when plicant can be heard personally, or by nt, before the Comptroller. If the ap- is not satisfied with the decision of the roller, he can appeal to the law officer, must first pay £3. In this simple hen, every patentee can be mulcted in n of £3 at the will of the Comptroller, an practically compel every applicant eal to the law officer or withdraw his ation. That regulation is manifestly for if the Patent Office compels the ant to appeal against its decision, it itself pay whatever fee is considered ary to the law officer. As a matter of r some reason or other, the authorities Patent Office have latterly refused a many applications for patents, some n no doubt for trivial or absurd so- "inventions"; but as they have ed others equally as trivial or absurd, who carefully watch these matters are ing to wonder what is the cause of nwonted action, and to hint a on that in future many appli- will be refused, in order he applicant may be compelled to extra to be allowed to appeal to the icer. We will assume, however, that plicant obtains his provisional pro- he must, then, within nine months ate of his application, leave or send lete specification, which may, like visional, be refused by the Comp- ntil it is amended to his satisfaction, eal being again open to the law rovided the applicant pays another rther, at this stage, the complete tion having been accepted, anyone t liberty, within two months of the the advertisement, to give notice of on (fee 10s.), and to assist him in a case he will be allowed to inspect plete specification on payment of have, in a previous article, com- on this extraordinary regulation, the great blot on the Act, and opens to fraud, for it puts into the hands ested opponents of an applicant ry information they require to ood their opposition. *Should there* be no opposition, the patent will be sealed, and the applicant will then have letters patent protecting his invention, but leaving him to prosecute any infringers at his own risk. Rule 23 provides that where, by inadvertence, &c., an applicant includes more than one invention in his specification, and the Comptroller refuses to accept it, the document may be amended, and the applicant may make separate specifications, which will bear the date of the original application, but each will be regarded as a separate patent, which must be paid for accordingly. The question of what are to be considered separate inventions must be left until, in the efflux of time, we are able to discover from the practice of the office and the decisions of the law officer how much can be included in one patent; but, according to the Act, "invention" means "any manner of new manufacture the subject of letters patent and grant of privilege within Section 6 of the Statute of Monopolies." As this section merely says that patents may be granted to new manufactures, provided they are "not contrary to the law, nor mischievous to the State, by raising prices of commodities at home, or hurt of trade, or generally inconvenient," it will be seen that the definition of an "invention" is left practically to the Comptroller, and beyond him to the law officer. The sooner an authoritative decision is given the better, for if sundry parts of one machine, each of which may form the subject of a claim, are to be regarded as separate inventions, the cost of patenting that "invention" may easily be very much more than it was under the old law. As the Board of Trade has practically unlimited powers to revise, amend, and alter the rules from time to time, it may be assumed that they will soon be brought into harmony with the spirit of the Act, the intention of which is undoubtedly to foster and encourage invention.

HOW TO MAKE A CHEAP LATHE.—VI.

Chucks.

WE have spent several pleasant and useful hours together during the construction of our lathe, and it is complete thus far. But unless we have chucks it is yet practically useless. In the selection of these, however, each one will consult his own special requirements, his pocket, his tastes and hobbies. The wood turner usually contents himself with three only—the pronged, the cup, and the face-chuck, all extremely simple. To these we shall add, for metalwork, the dead centre and carrier, the slotted face-plate, the cup chuck with screws, the drill chuck and plate, and the cone plate. Also a small circular saw. Anything more elaborate than these could hardly be deemed essential or common accessories to a "cheap lathe."

The pronged or fork chuck is used for turning wood between centres, and is made of steel. Its shape is indicated in Fig. 61. Turn the forging in the lathe, using carrier and driver, cut the screw with stock and dies, and file the fork nearly to shape. But before finishing, screw it into its place on its own mandrel nose, and turn the point *a* true. Put the finishing touches to the prongs, and have their tips hardened.

The cup chuck, Fig. 62, and face plate, Fig. 63, will each have a plain pattern, made similar to their castings, except that the holes for the mandrel screws will be cored small enough for tapping, say, with a core $\frac{3}{8}$in. in diameter. Having the castings, take either one of them (the same directions applying to each), and clip it, face inwards, in the dogs or jaws of a face plate. Face the portion which bears against the collar of the mandrel, bore the cored hole with a turning tool, set in slide-rest, in preference to a drill, and putting on the change wheels, cut the internal thread, chase till it fits easily, but without slop, on the mandrel nose, then turn it up truly in its own lathe. Drill countersunk holes for wood screws in face plate, also one $\frac{1}{4}$in. hole through the boss *a*, to receive the driver for the carrier, which is used with metalwork between dead centres. We will also adapt the cup chuck for metalwork, by drilling and screwing $\frac{5}{16}$in. holes, Fig. 64, and cutting tightening screws to match. The trouble of forging and turning these screws can be avoided by purchasing common set screws, say, 1in. by $\frac{3}{8}$in. with square, hexagon, or round heads, and tapping holes to match.

We shall make a dead centre for the headstock mandrel, turning it out of a piece of steel and screwing as in the poppet centre (Art. IV., Fig. 42), the only difference being that the thread will be $\frac{1}{2}$in. instead of $\frac{3}{8}$in. We can finish the point in its place, after which it must be hardened.

Get a carrier forged to dimensions (Fig. 65), drill and screw the boss, and make a set screw. A second carrier (Fig. 66) of smaller dimensions will be convenient, and for turning bits of wire, small rod, binding screws, &c., a carrier or two made from small nuts (Fig. 67) will be found extremely useful. By letting the set screw stand out a considerable distance, as shown, we avoid the necessity of shifting the driving pin in the face plate.

An extra face plate cast with slots will be desirable, on which to bolt metalwork, with or without an angle plate. The slots (Fig. 68) will be cored out, prints being put on the face of the pattern corresponding in position with the slots required, and a core box will be made equal in depth to the thickness of print and plate combined.

A simple square-tapered drill chuck (Fig. 69) can be made without much trouble. When forged and screwed (mine, I may note, is of brass), run it into its own mandrel and drill a $\frac{3}{16}$in. hole $\frac{7}{8}$in. deep. With a $\frac{3}{16}$in. cold chisel chip a taper square hole to the dimensions we intend to make the shanks of our drills. Clean out with the point of a square file, trying the accuracy of our hole with a drill run round from time to time in the lathe, until the drill revolves truly—does not "wobble" in the chuck.

A drill chuck necessitates a "drill plate"; that is, a plate to carry forward the work which is being drilled. Art. 3, Fig. 17. In our case, we shall just slip the plate over the poppet mandrel, temporarily removing the dead centre in order to do so. Make it to dimensions, Fig. 70; and if the hole in the boss is bored accurately, its length of bearing will insure steadiness of the plate while the drilling is being performed. The poppet being screwed down on the bed, the progress of the drill can be regulated with the greatest nicety by the handwheel attached to the traversing screw.

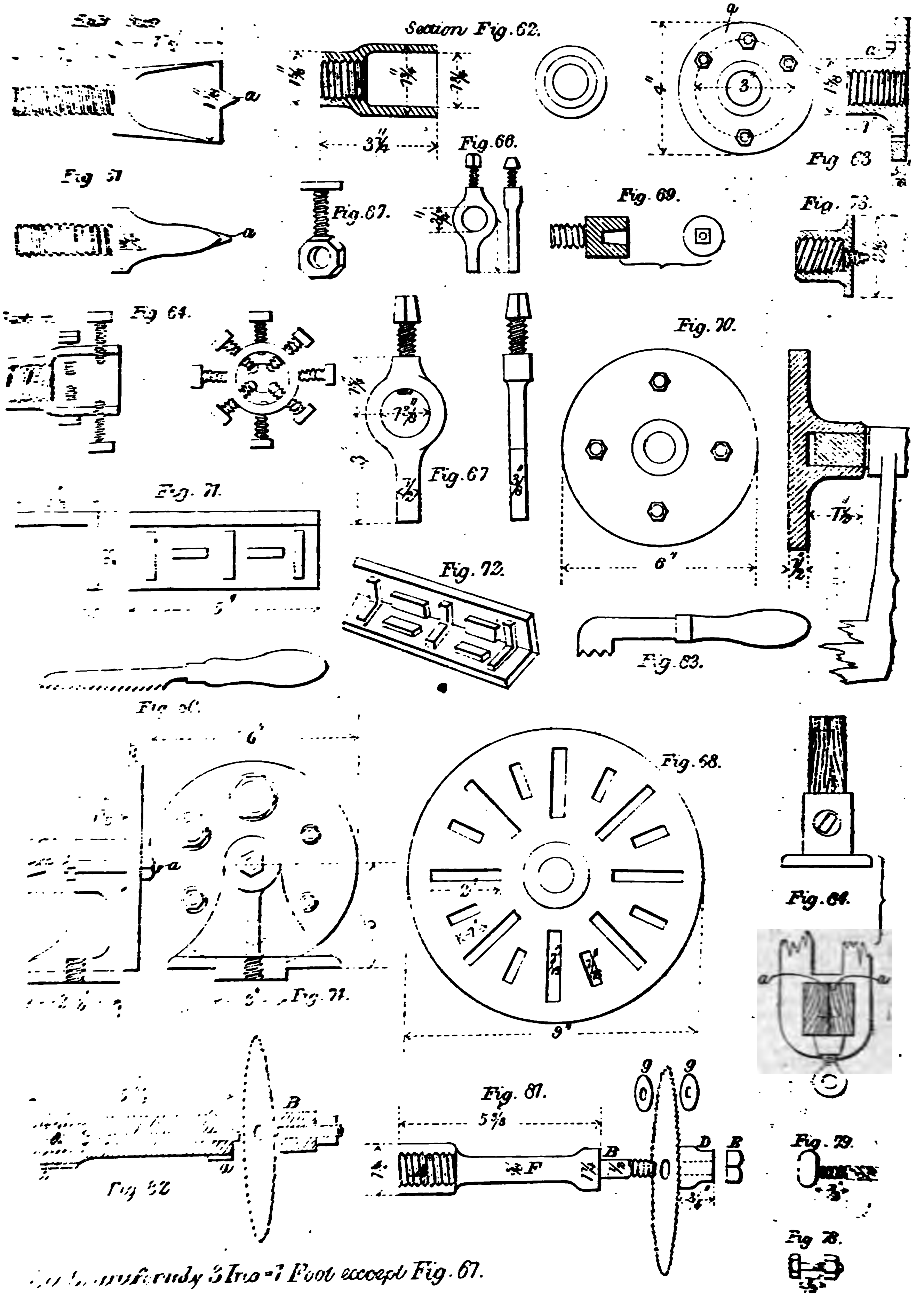
Some of our readers may wish to add accessories to their lathes besides those we have described. An angle plate, Fig. 71, would be found useful for fastening irregularly-shaped pieces of work at right angles to the slotted face plate. In casting the slot holes, it is necessary for moulding that two kinds of prints be used; one set of prints being of the ordinary type, the other set of the type known as "pocket prints." Fig. 72 represents the pattern with prints.

A faceplate like Fig. 73, with a tapered screw, is often used for chucking small articles where wood screws are inconvenient or impracticable. The central hole must not be cored right through, but a sufficient thickness, say $\frac{3}{8}$, must be left, into which to tap the screw. The taper thread can be hand-filed.

An additional cup chuck or two may be added with advantage, increasing thereby the capabilities of our lathe: one of brass, say $1\frac{1}{4}$in. in diameter, and one of cast iron from $2\frac{1}{2}$in. to 3in. diameter.

A cone plate is sometimes desirable, as we found in drilling up the ends of our mandrels. Fig. 74 gives a cone plate adapted to this lathe. Cut the holes out in the pattern, just skimming them round true afterwards in the casting. Note that all the holes are in one centre line corresponding with the lathe centre, 5in., so that angle and cone plate together can be transferred to the lathe in an instant, fastened to the bed, and no further adjustment will be necessary than just to turn the hole we want to use uppermost, and there fix it with tightening bolt, *a*.

A circular saw economises a lot of precious time, and is, therefore, a desirable acquisition. The one sketched, and described in the following paragraphs, I made, with certain slight modifications, after the model used by a wood turner of my acquaintance, who has three saws of various sizes, each rigged up in the same fashion. Fig. 75 shows the tool ready for use. A is the



... uniformly 3 Ins = 1 Foot except Fig. 67.

... guide, C the spindle, D ... combined.

... flanged round its under ... rigidity with lightness. ... purpose of making a ... the headstock, Fig. ... and when finished, ... horizontal with the spirit level. Grind or file the top of the table moderately true, and polish with emery cloth. Treat the edges in a similar manner. Drill a couple of holes, and file them to ⅜in. square in positions indicated (Fig. 76 *b b*). These are to receive the square shoulders of the bolt for the movable slide, and we have two holes in preference to a long slot, which would weaken the plate.

The movable slide, (Fig. 77), should have i face and edge *a a* filed flat and square, and th guide strip is also to be filed to a right angle wi the face. The slot *c* is cast in, and cleaned ou with a file. The bolt (Fig. 78) tightens it in an required position.

Drill a ⅛in. hole in the side of each bracke which comes from underneath the table, i

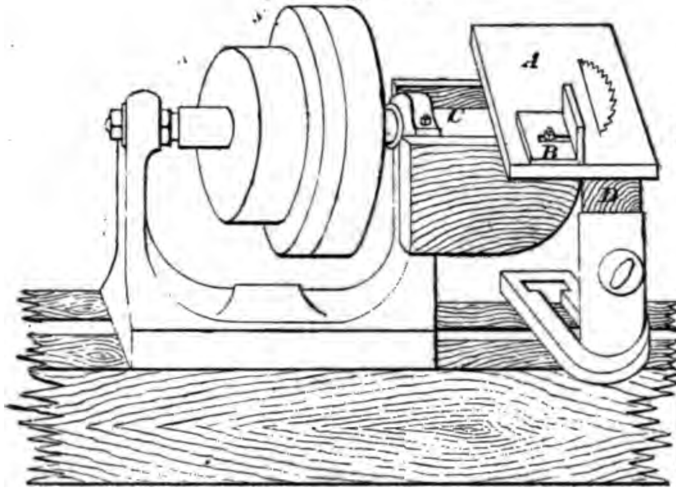


Fig. 75.

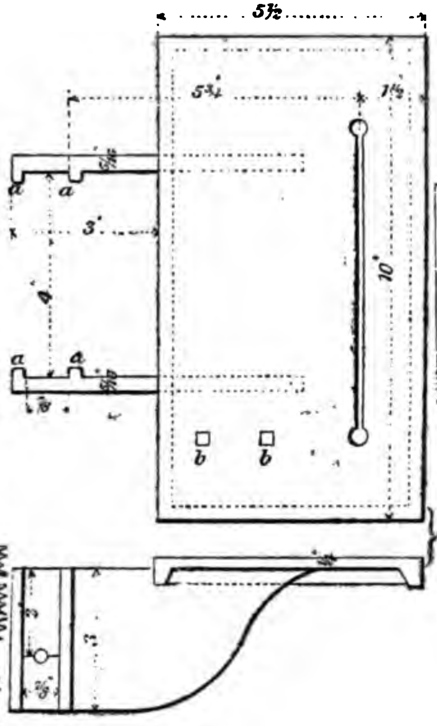


Fig. 76

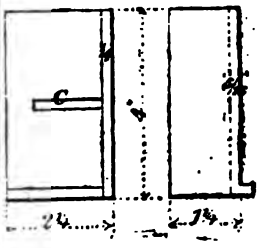


Fig. 77

position given (Fig. 76). Slide them over the headstock until the top of the table stands about ¼in. above the centre of the lathe mandrel. While in that position mark two holes with a scribe on the edge of the headstock face, corresponding with those just drilled. Drill in about 5/16in. deep, quite enough for the work they have to do, and tap. Make a couple of thumb screws (Fig. 79) tapped to fit these holes. They simply prevent the table from slipping downwards, the bearing strips retaining it in other ways.

Now, while held in its permanent position by the screws, mark a line as nearly at right angles with the axis of the lathe as possible, at a distance of 5¼ away from the collar of the mandrel nose. Better lay a straightedge in winding with the edge of the bed, sighting down from above, and mark the line off from this with a set square. On the line so obtained set off 2⅞in. on each side of the axial centre line, and in these two points drill holes with a 3/16in. drill. Get an old stump of a keyhole, or compass saw, about 6in. or 7in. long, and file just double the usual quantity of teeth in it; that is, convert each tooth into two, making them hacksaw shape, Fig. 80. Start at one of the drilled holes, and saw a slit down the iron plate, terminating in the other hole. This is to receive the saw.* A portion of the flange underneath the table will have to be cut away to clear the spindle, and this will complete the plate.

The spindle which carries the saw I made of brass; but those I copied from had spindles of hard beechwood. I will describe each, and leave my readers to choose between the two.

Fig. 81 is a solid piece of brass casting, screwed to fit the mandrel nose A. At the end marked B there is a parallel portion turned to fit the hole in the thick washer D, beyond which there comes a ¾in. thread for the tightening nut E; *g g*, are two leather discs put, one on each face of the saw to prevent it from slipping round. I think I would recommend anyone making a spindle of this kind to have the narrow shank marked F a little larger in diameter, and to lighten it out with a core. Make it ¾in. in diameter, with a ½in. core, for instance. It would thus be lighter, yet equally strong.

The wooden spindle, Fig. 82, is shown in section. The screw A can be cut either with a V-tool by the change wheels, or with a chaser by hand. A chaser made to fit the mandrel thread, Fig. 83, will be always handy for rigging up a temporary chuck, and a little practice will enable one to use it readily. We imagine the initial difficulty got over, and our screw cut to fit the mandrel nose. Get a ⅜in. button-headed bolt 5in. long, having a square shoulder under the head, and bore a hole in the lathe half way through the block of beech to receive this bolt. Take the block out of the cup chuck, screw to its mandrel, and bore from the other end till the holes meet. Face to 5⅜in. long, turn the outside, and drive on a ferrule at each end (Fig. 82, *a a*). Then shoulder the hole at the backend to receive the square neck of the bolt, and drive it in. A hard wood washer B completes the arrangement, and the friction of the wood is amply sufficient to prevent the saw from slipping round.

The packing block (Fig. 84) serves for packing and for support. It fits in the socket of the rest, and touches the underside of the table, thereby deadening vibration. It is grooved to receive the saw, and has two recesses *a a* to take the oiled hemp packing by which the saw is kept cool, and the steadiness of its motion assisted. In cutting thick stuff, say, 1½in. thick, it may be well to support the spindle by bringing the poppet centre up to it; but there is no need of additional support in light sawing.

These various accessories are not likely to be procured at once, since they involve a deal of manual labour in their construction. In all probability, after making the lathe itself, most will remain content with the prong and the cup chuck, and the face plate for awhile. Considering the cheap lathe as being complete at this stage, the cost is:—

		s.	d.
Face plate and cup chuck (brass) 3¾lb. at 1s.		3	9
Fork chuck, say		1	0
Miscellaneous fitting (Art. V.)		15	0
Woodwork (Art. II.)		10	0
Castings (Art. I.)		15	0
Total	£2	4	9

Say £2, and mine had not cost me quite so much at this stage.

In the articles remaining, the labour is greater than the expense, which latter is approximately as follows:—

	s.	d.
Spindle for saw and washer (brass) 2lb.	2	0
Cast-iron work, 30lb., at 2d. per lb., being very light work	5	0
Wrought-iron, bolts, &c., 3lb.	1	0
6in. saw (German or English), from 4s. to 6s.	5	0
Total	13	0

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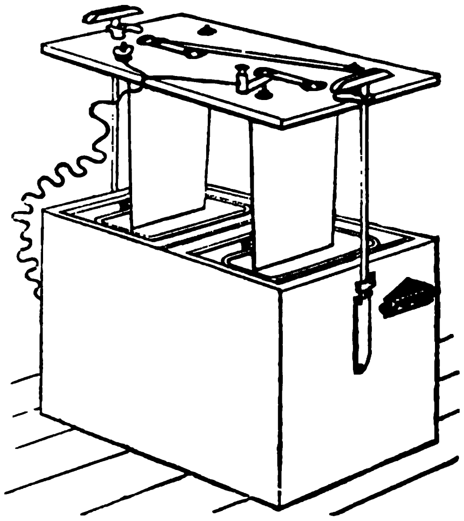
* A word about this cutting of the slit. It would occur to many that it might be cast in. In that case its opposite edges would most likely become buckled, or perhaps be out of parallel, in consequence of the metal not running up clean and sharp. And, with respect to the sawing it down, a soft saw will be of no use, nor, indeed, any saw if the metal is hard. With a piece of an old, highly-tempered saw, approaching in hardness to a hacksaw, and a plate cast from "No. 1 Scotch" iron, the task is easily accomplished. But in the absence of such a saw, and having, perhaps, some hard metal in the plate, the best way will be to get a drill a full 1-16in. in diam., and to drill a quantity of holes all down the centre of the intended slit, just touching one another. Then opening two or three of the end holes with the point of a file, complete the slit with a flat ward file of 1-16in. in thickness. The holes can be drilled rapidly in the lathe by means of a drill chuck.

THE NEW "EDCO" BATTERY.

THIS battery consists of a wooden box divided into two lead-lined compartments. The zinc plates are screwed in holders on a board, and the carbons, to avoid breakage, are fastened permanently in the cells. The inside measurement of each compartment is as follows:—Height 12in., width 8in., length 6in. The plates, of which there is one zinc for each cell, and two carbons, are all 10in. by 6in. by ¼in. thick. The zincs weigh exactly 3lb. each, and cost retail 2s. each. A porous pot is used, and in the outer compartment is put a solution containing 1½lb. bichromate of potash, and 3lb. of sulphuric acid. These are supplied by the makers of the battery to their customers respectively at 6d. and 1d. per pound. Six ounces of sulphuric acid are put in the porous pot, which is then filled up with water. With this charge, costing as above, 1s. ½d. the battery will run motors and light incandescent lamps with absolute steadiness for 60 consecutive hours, or about 90 hours if worked at intervals of, say, 10 hours at a stretch. During this period the only attention the battery requires is refilling the porous pots every 20 hours. Each cell of the battery gives on short circuit two volts and five ampères steadily. The method of filling the battery, and an illustration of it are given below, and it may be seen at work at the offices of the Electro-Dynamic Company, Archway House, Bush-lane, E.C.

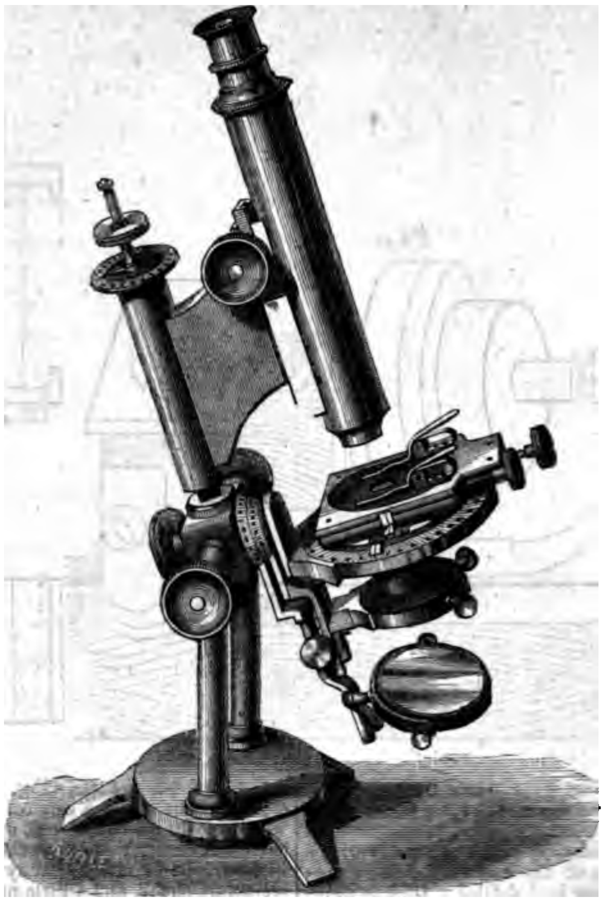


The following is the method of charging the two-cell "Edco" battery with porous cups:—Have ready twice one and one-half pounds of bichromate of potash and twice three pounds of sulphuric acid. In each lead cell pour six pints of water, and in each repeat following operation: —Fill the colander with bichromate of potash, and hang it in the cell so that the crystals are just immersed in the water. Pour about one-fourth of the three pounds of sulphuric acid over the crystals in the colander slowly, stopping occasionally when the liquid boils. As fast as the bichromate of potash gets dissolved, add more, and continue pouring on sulphuric acid as before, until there are used up for each cell, all of one and one-half pounds of bichromate of potash and three pounds of sulphuric acid. When the liquid is entirely cool, it is ready for use. After the porous cups have been put in the red fluid, this should not reach higher than within about 2in. from the copper strips on the carbon plates in each cell. Should it not come up that high, add water.

The porous cups which receive the zinc plates are to be filled with water to within about 2in. from the top, and then add six ounces of sulphuric acid.

It will be noticed that after the porous cups have been in the cells about 24 hours (whether the battery has been in active use or not), the surface of the liquid in the porous cups has gone down about an inch, which must be brought up by adding water, or better still, water to which sulphuric acid has been added in about the same proportion as the original contents. After the battery has been in use ten or twelve hours, it is advisable to amalgamate the zincs, as by doing this they are kept in very good condition, and do not require much attention for some time.

PELLETAN'S "CONTINENTAL" MICROSCOPE.



THIS microscope has been issued by Dr. J. Pelletan, of Paris, and claims notice not for any distinctive feature in design, but as a combination of several points which have hitherto been confined to English or American models, together with the focusing arrangements and connection of the body-tube with the pillar generally adopted on the Continent.

The principal novelty to the Continental public is the adoption of the swinging tail-pieces to carry the substage and mirror, each moving radially to the object on the stage, after the plan modified by Bulloch, of Chicago, from Zentmayer's "Centennial" microscope.

The substage, with centring movements, fits on the first tail-piece behind the stage, and is worked by rack and pinion. The mirror is mounted on a crank arm on the second tail-piece. The tail-pieces swing laterally either together or independently; each is provided with a graduated collar for registering the lateral rotation, and a spring-pin drops into a corresponding notch, fixing each in the normal position when axial light is required.

The stage is circular, and rotates about [illegible]ths of a turn; it has graduated divisions near the edge. "[illegible]" are applied to the mechanical rectangular movements. It is attached to the lower end of the inclining column by a conical axis passing through and secured at the back by a large milled nut. This stage can be removed and a glass friction-stage substituted, which can be used reversed for oblique illumination from the mirror, &c. The friction-stage is fitted with a hemispherical lens so that its plane face is flush with the surface of the stage as in Tolles's and other microscopes.

The focussing arrangements are of the usual Continental type. A scale is applied on the side of the body-tube working against a fixed vernier on the limb for recording focal distances by the coarse adjustment, while for finer measurements a graduated disc is fixed on the top of the column carrying the limb, and the fine focussing screw rotates with an index pointer, by which the number of turns and fractions can be registered.

The body-tube is much larger than is usually adopted on the Continent, and will admit an extra draw-tube supplied with the microscope, [illegible]. As arranged in the figure, [illegible] the larger [illegible] in the body-tube and carrying the smaller, in which the [illegible] gauge of eye-pieces are used. The [illegible] is applied at the top [illegible].

The suspension of the inclining column between the standards appears to have been devised without regard to the balance of the instrument.

The trunnion axis is very nearly at the lower end of the column, so that the stability of the position of inclination is entirely dependent on the tension of the clamp-screws on the ends of this axis; if the unwary operator should loosen the clamp-screws without supporting the column the optical part of the microscope falls forward or backward, in either case striking the table, as no stop-pins are provided either to mark the vertical or the horizontal position.

The microscope is manufactured by E. Lütz, and appears to us to require thorough revision both in design and construction.

PRACTICAL NOTES ON PLUMBING.—XC.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from p.* 361.)

Dormers.

THESE are sometimes covered all over with lead, and at other times part slated, &c., as shown at diagram 428. First put on the apron Y, then the cheeks C H E E K, which should go over the springing as at G, and from 4in. to 6in. under the slates according to the pitch of the roof. The cheek should also go up under the valley lead V T, and the valley lead over the cheek, under the slates, both on main roof, and on of the dormer, as shown by the dotted lines, finished as shown. Let the cheek lead go r the jambs of the window, and be turned w welt as shown at W to cover the nails. nails are shown under the welt by the lines.

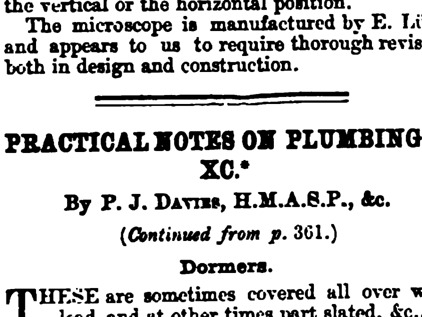


Fig. 428.

Hips and Ridges.

The method of doing this work is sh diagram 429. A is the roll, S the s

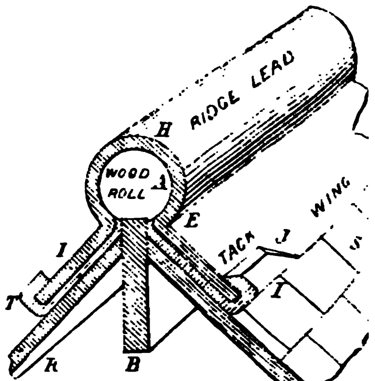


Fig. 429.

I H E J the lead work, I J the tack to l lead firm in the roll. In doing this w that the lead is well home to the angle of and slates, and that the tacks are put, a 2ft. 6in., and of at least 7lb. lead. Th of the work depends greatly upon the of putting the tacks. After the lot i place, trim the lead true to a line.

Spires, &c.

I shall now give two or three methods this kind of work, although it is not one out of twenty who will ever be called cover one. Hence the reason why I sho little more minutely into the work. I w at diagram 23. This is composed si straight pieces of lead nailed on to the b as at 1, then the roll nailed on over the of the first bay. Having the first bay nailed on, and the ends of the bays to

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s. next proceed to work the bay No. 2, which ıld be worked to form an overcloak to the : roll, and in such a manner that you can work overcloak down round the roll, and leave a d splash-lap properly tacked to prevent it ving. The rolls should be nearly round, so the lead may rest well in the angle of the and boarding, which will prevent the from getting away. Having the bay No. 2 y, put it in its place and *well* nail it along :op and down the side rolls. After this fix No. 2 over the bay No. 2, and so on, all up side. In this method the ends of the bays worked over the side rolls, or hips. Some ıbers lay the bays and afterwards cover the with separate pieces of lead; but when this is done it is more work without getting any advantage.

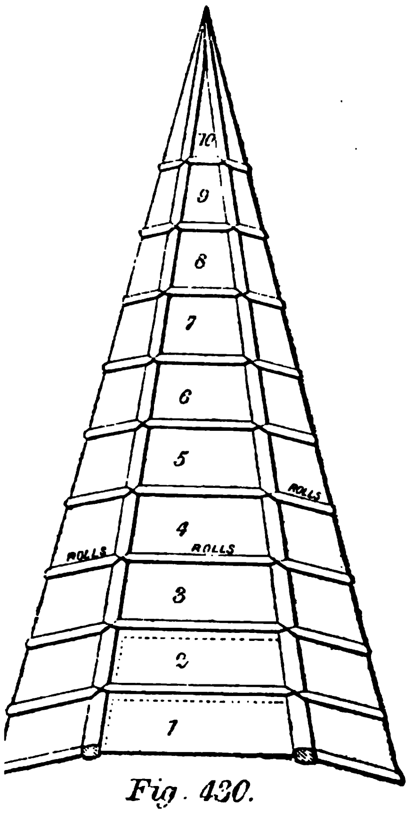

Fig. 430.

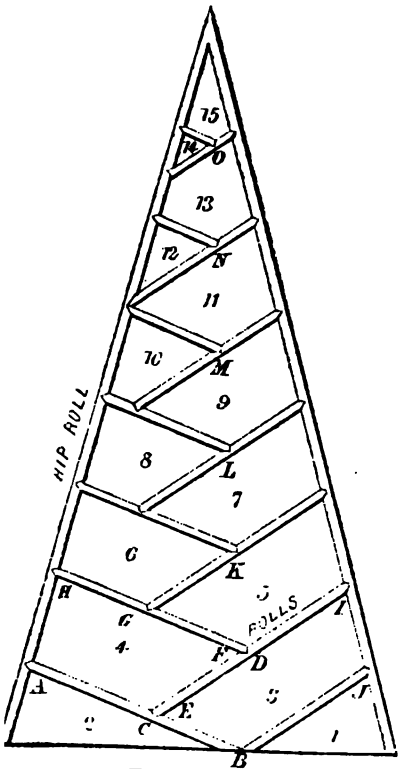

Fig. 431

Zig-Zag Work.

This is shown at diagram 431. It is very useful in places where long lengths of lead cannot be used, and where the spire is over 9ft. across. see 1, 2, 3, 4, 5, 6, 7, 8, diagram 431. First fix the bays either 1 or 2 with the undercloaks, as you did in diagram 430, or as you would do in a common flat. For my part, I prefer to nail the undercloaks under the roll, as from what I have lately seen this stands much the best, to say nothing about the work. Having got bays 1, 2, and 3 into their places with good rounded rolls and plenty of tacks, proceed to work down the overcloak over the first roll from B to C, and from B to J, and so on all up the spire. You may work the side rolls with the ends of your bays, or by separate pieces of lead as before mentioned. When executing this class of work there are several objects to keep in view. The first is perfect soundness of work. Second, that the pieces of lead put on are not too large, as they will be affected by the temperature of the atmosphere. Third, that the point of the rolls are in a line as at B D K L M N O, and their intersections perfectly worked; also that the other line of roll ends are running straight. These two lines of roll ends cannot be maintained unless every bay is set to a different width, which makes a great difference in the cost of the work. Such work is shown at diagram 432, and notice that it is impossible to work the ends of the bays at diagram 431 on the square as in diagram 432—namely, up against the side rolls. In diagram 432, the ends of the bays may be cut square, A B C D E F G H, &c., and if so, the bays will become smaller from the bottom upwards—that is, if the intersecting line is maintained. The top part may be varied as shown at 16, 17, 18, 19, and 20.

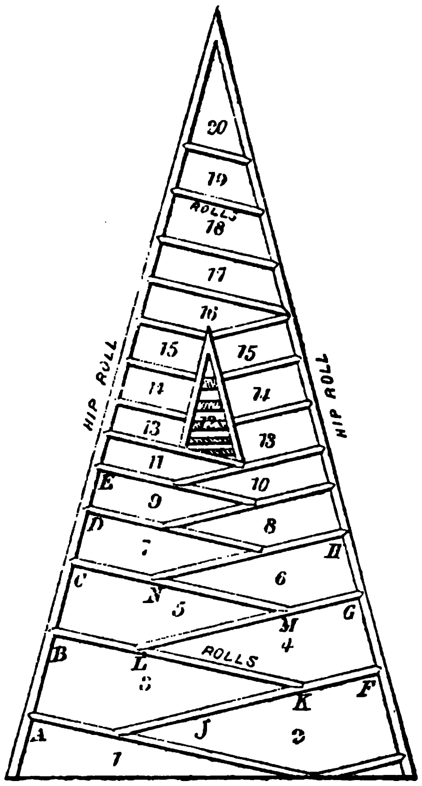

Fig. 432.

(*To be continued.*)

LANTERN TRANSPARENCIES BY THE ALBUMEN PROCESS.*

IT may be interesting to many to know the old system of working, so that they can realise the difficulties attendant upon it, which gave rise to so much prejudice against the albumen process, particularly amongst amateurs. Accordingly, before commencing the details of the modern method, we shall digress for a moment to give a brief outline of the old process, so that the more "recent" improvements may the better be understood and, therefore, appreciated. In the earliest methods the plate was coated with plain uniodised albumen, and then dried. The iodising of the film was afterwards effected by exposing it to the vapour of iodine, in the same manner as in the daguerreotype process, until it became decidedly of a yellow tint. It was then sensitised by immersion for a short time in a solution of nitrate of silver strongly acidified with acetic acid, similar to that employed in the calotype process. An improvement on this plan was effected by adding an iodine to the albumen itself, which simplified matters considerably, as it did away with at least one troublesome and disagreeable operation. The method of working was this:—A certain quantity of albumen was taken, and to it was added the proper proportion of iodide of potassium. The addition of bromide was also made by some workers. The whole was then whisked into a stiff froth. The directions usually given for this part of the operations were that the albumen should be whisked until the vessel containing it could be inverted without the contents running out. After standing some hours for the albumen to subside it was ready for use.

The plates were coated in the following manner:—They were first affixed to a plate-holder, which consisted of a piece of guttapercha fastened on the end of a stick, as pneumatic plate-holders had not been invented at that period. The guttapercha was made sticky by melting it in the flame of a spirit lamp, and the plate attached. The albumen was now poured on and distributed, and afterwards equalised by centrifugal force, by giving the plates a rapid rotary motion by spinning the stick between the fingers. The plate was then detached, and put into the drying-box. This consisted of a box containing a number of grooves into which shelves of porous wood fitted horizontally, the box being mounted on levelling screws. Previously to using the box the shelves were removed, and placed, together with the box, either in the sun or in front of a fire to thoroughly desiccate them, so that the wood should be rendered as absorbent as possible. The shelves were now replaced in the grooves, and the box carefully levelled. It was then ready for the reception of the plates, which, it will be seen, were dried entirely by the moisture from them being absorbed by the wood of the shelves and box.

Now it is clear that if the box were not accurately levelled, or if the shelves had become warped, the films would be of unequal thickness, and the plates, consequently, useless. Up to this point dust was the greatest enemy, for the smallest particle settling on the film was almost certain to cause a spot, and it will be noticed that up to this time the plates were always in a position to favour floating particles coming into contact with them. The sensitising was effected in a bath of aceto-nitrate of silver in much the same manner as at present. But the development was materially different to that now practised, inasmuch as the picture was brought out with a saturated solution of gallic acid, with a few drops of aceto-nitrate of silver added, instead of, as now, with pyro-gallic acid. The time occupied in the development of a picture by gallic acid was rarely much less than half an hour, and it frequently took as much as a couple of hours if it were at all under-exposed. But, by the method about to be described, it does not take much longer to develope and fix an albumen than it does a gelatine plate.

Having thus given a short outline of the old-fashioned albumen process, we shall proceed with the details of the present system of working. In the first place, we commence with the preparation of the albumen itself—say of ten ounces. This will require from a dozen to fifteen eggs, according to their size. These, if available, should by preference be "new laid," though good French eggs will answer nearly, if not quite, as well. The eggs must be broken, and the whites carefully poured away from the yolks, keeping the latter in the shells. The germs should then be separated. To ten ounces of the albumen half a drachm of glacial acetic acid in half an ounce of water is added, and the whole intimately mixed by stirring with a glass rod. No attempt should be made to cause it to froth, which if done would give rise to trouble. Half a minute's stirring is all that is necessary. The acid will produce a precipitate, and render the albumen exceedingly limped. After standing a few hours it is passed, first through a piece of muslin to remove the coagulum, and afterwards filtered through a piece of sponge plugged in the neck of a funnel. After filtration forty minims of ammonia, ·880, is added, which causes the albumen to regain much of the viscosity the acid had destroyed. Albumen thus prepared will keep quite good for many months, if preserved in well-corked bottles. This method of preparing the albumen, if our memory serve us correctly, was first published by Mr. William Ackland.

For use, the albumen is iodised by adding one drachm of iodide of ammonium dissolved in half an ounce of water; sometimes ten or twelve grains of

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* From the *British Journal of Photography.*

[illegible] The albumen being ready, [illegible] the plates. For this purpose [illegible] is required. Any common [illegible] that has been used for a length of [illegible] to yield an even and [illegible] be very old it will possibly [illegible] film, in which case a little [illegible] must be added to give it body.

The glass plates being thoroughly cleaned and [illegible] is taken and coated with the [illegible]. After this has been allowed to set the plate is immersed in a dish of common water, where it is allowed to remain, with occasional agitation, until all greasiness has disappeared. It is then rinsed under the tap and placed standing on a pad of blotting-paper to drain, while another plate is being collodionised. Now take the drained plate and pour over it, beginning at one end, a little of the iodised albumen. Flow it over in a wave, so as to carry the superfluous water before it, which, with the albumen, should be allowed to run off into the sink. Drain the plate somewhat closely and apply a second lot of albumen, avoiding air-bubbles, and keep it in motion on the plate for half a minute or so in order that the albumen may penetrate into the collodion film. Then pour off into a measure, and stand the plates in a rack to drain. The second lot of albumen from one plate will do for the first application to the next, and so on. By this means the albumen will be economised.

After a dozen plates have been coated, take the first one and hold it in front of a clear fire until it is dry, and so, in turn, with the remainder. When the plates are dry it is a good plan to make them as hot as the hand can bear, for this treatment will prevent the films from blistering in the after operations, which otherwise they may have a tendency to do with some samples of collodion. Instead of drying the plates by the fire some prefer to allow them to dry spontaneously; but, in this case, it will be found a good plan to make them thoroughly hot, for the reason just mentioned. Plates thus prepared will keep for years if preserved in a dry place. It need scarcely be mentioned that all these operations may be performed in open daylight.

ALCHEMY AND MODERN SCIENCE.

THE course of six lectures to juveniles at the Royal Institution was commenced by Prof. Dewar on the Thursday following Christmas-day, and, as usual, the theatre of the Royal Institution was crowded. The full title of the series is "Alchemy in its Relation to Modern Science," and the lecturer said that the topic had been chosen because it appealed to youthful imagination and led up from "striking" experiments to matters of not less interest than utility. The word "alchemy" blended the Arabic definite article with the name for Egyptian science, which reference to the country of its birth still held its ground in our word chemistry. Some etymologists emphasised in this connection the original meaning, "heat," in the national name Chemi, for "the land of Ham," or "of heat." For alchemy could do nothing without "heat." It had especially to do with the changes wrought by this great agent in the crucible or the furnace, changes promising its votaries a royal road to health and wealth. It aimed at the transmutation of the baser metals into the nobler, silver and gold, and at the production of the elixir of life. The mainspring of its research was thus the securing of human happiness. The five periods of the grand science were (1) that during which it was practised by the Egyptians, Hebrews, Arabs, Indians, Greeks, and Romans, when it was nearly co-extensive with metallurgy. (2) that of the Alexandrian school, when it became occult, sacred, religious, [illegible]. (3) that of the Middle Ages, during which many valuable discoveries was stumbled upon by those who hardly dreamt of their importance to medical science in general; (4) the period of the study of facts for their own sake, during which alchemy touched its vanishing point; (5) lastly, alchemy became altogether sublimed into modern chemistry. Speaking briefly of the first epoch, Professor Dewar reminded his youthful audience that the earliest thing to impress itself on the minds of men wherever their history could be traced, from the Arctic Circle to the Torrid Zone, was [illegible] and the method of its production. Fire was kept [illegible] burning in Egyptian temples and in [illegible] of the Vestal Virgins at Rome. It was [illegible] of fire that made it a symbol of life. [illegible] shown of the diverse effects of [illegible] and sulphur respectively, and of [illegible] in the residual products where there [illegible] at all. Wood and charcoal left [illegible] sulphur which in burning created an [illegible] atmosphere, possessing, however, the [illegible] bleaching, quite vanished. The [illegible] of the changes brought about [illegible] kindled speculation, and alchemy in [illegible] into metallurgy, which, again, [illegible] the metals in the order of their facility [illegible] gold, silver, copper, tin, iron, lead. Pottery gave the rude alchemists the advantage of earthen furnaces, instead of the rock-crevices before used. The metals were classed as noble or base according to their ability to stand fire without change. A great passion then seized upon the alchemists to transmute the baser metals into the nobler by purging them from all alloy. Quicksilver shared with sulphur the wonder of the ancient alchemists, by whom the metals were ranked according to their relations to these two mysterious agents. Professor Dewar's second lecture was delivered on Saturday, the theatre being crowded with boys and girls, who evinced a keen and intelligent interest in the instruction imparted, especially in the experimental illustrations. The lecturer told them that the ancient Egyptians were acquainted with many chemical facts and phenomena as long ago as about B.C. 2,000, as could be proved by their extant monuments. Recapitulating what had been said about sulphur in the first lecture, he said these ancient chemists appeared to have thought its relation to the metals analogous to that of mercury, whereas it really disguised them, as was shown by combining sulphur with red hot iron, the product being seen by the audience to be utterly unlike either of the elements employed. The old chemists knew a good deal about the mixtures of metal with metal, which are termed alloys, as well as about amalgams, the special names given to the combinations of mercury with solid metals. They doubtless had many things to learn; so had we, as, for instance, in the discovery quite lately of a new peculiarity in gold, which, after having been handled chemically for more than 3,000 years, had now first been observed, after subsiding from the dazzling brightness of its molten state into dulness, to flash forth once more into all its former brilliancy. After interesting experiments on pure silver and its amalgam with mercury, the metallurgical operations of the ancient Egyptians were illustrated by the pictures painted on the walls of their tombs. The first slide passed through the lantern reflected on the screen their use of the blowpipe, their hammering and forging into shape the metals under treatment, their careful weighing of the raw materials and of the manufactured articles, their use of fluxes, and the like. He next represented the goldsmith working at his trade and mystery, surrounded by all his tools and appliances. A third wall-painting showed the Egyptian god Thoth—the Hermes of the Greeks—in his laboratory; for he was the tutelary god of the science, and the writings conned by the alchemist were styled in honour of him the Hermetic books. In literary works of this kind could be traced back to about the beginning of the Christian era such curious knowledge as this, that water sometimes loses its quenching power and fire forgets to burn. There was a story on record also of a Zoroastrian pontiff who made many converts by allowing 18lb. of molten copper to be poured over his naked body without suffering harm. To show the possibility of a fact which might easily have grown into such a myth, Professor Dewar, having first carefully washed his hands in distilled water, plunged the right, while still moist, into molten lead, and repeated the experiment thrice with perfect impunity. In point of fact, as he remarked, his hand and the molten metal into which he dipped it for an instant never came into contact. The very early acquaintance of the Egyptians with the alkalis and with the art of making glass was also demonstrated. To illustrate the elasticity and ductility of glass, about a league of glass silk was spun from a wheel, to the great delight of the children, at the rate of nearly a mile a minute.

THE CANNON, THE STEAM-ENGINE, MAN, AND THE INSECT CONSIDERED AS MECHANICAL MOTORS.

UNDER the above title, we give a *résumé* of some very curious and interesting information published in a recent work of Mr. E. Jouffret, entitled "Introduction to the Theory of Energy."

These examples, which are submitted in a simple and clear way, are well calculated for disseminating a knowledge of the phenomena of conservation and transformation of energy, by presenting them under a concrete form accessible to all those who are not making a special and continued study of them.

A 100-ton cannon (Italian model of 1879) cost 400,000 francs. It requires a 250 kilogramme charge of powder, and throws a projectile weighing 917 kilogrammes, with an initial velocity at the mouth of the cannon, of 523 metres per second.

The energy possessed by the projectile, in the form of live power, is 12,772,000 kilogrammetres.

The energy represented by one kilogramme of powder is, according to Noble and Abel, 300,000 kilogrammetres, or 75,000,000 kilogrammetres for the charge of 250 kilogrammes.

The cannon considered as a machine, converts, then, into work seventeen per cent. of the total energy of the combustion of the powder. This figure is higher than that furnished by the best steam-engines, as these convert into work less than ten per cent. of the total energy represented by the coal.

It is the animal machine in which the performance is the highest, and this fact may be established in a particular case, as follows:

According to the Guide Joanne, the ascent of Mont Blanc, starting from Chamounix, is effected in seventeen hours, resting spells not included. The difference of level is 3,760 metres. A person ascending, who has a mean weight of 70 kilogrammes, produces, then, in order to rise, a work of 3,760 × 70 = 263,000 kilogrammetres. This work is borrowed from the heat that the carbon and hydrogen contained in the food eaten disengaged upon being burned in the lungs. For the sake of simplicity, if we reduce the entire energy to a combustion of carbon, and recall that a kilogramme of the latter furnishes 3,000,000 kilogrammetres, we find that the 263,000 kilogrammetres represented by the ascent correspond to a consumption of 94 grammes of coal—a consumption that comes to be added to the normal rations necessary for the operation of the organs during a state of rest. Such consumption is 8·35 grammes per hour, or 142 grammes for the seventeen hours. The total consumption of coal is 256 grammes, representing 708,000 kilogrammetres. The performance, then, is:—

$$\frac{263.000}{708,000} = 37 \text{ per cent.}$$

The performance of the human machine drops to 21 per cent. when we consider a period of 24 hours composed of ten hours of work and 14 of rest, and a mean daily work of 280,000 kilogrammetres.

The cannon, considered as a machine, is incomparably superior to the steam-engine as regards the time necessary to produce a given quantity of mechanical work.

Thus, for example, the 100-ton cannon develops in one hundredth of a second a quantity of work equal to that which would be *yielded* by a 47 horse-power steam-engine in *one hour.* A man of average strength is still lighter than an ordinary steam-engine of equal power, *but he is much* inferior to the other animals *of creation,* and particularly to insects.

Thus, for example, the libellula, which is capable, without apparent fatigue, of following a train of cars for several hours, giving its wings during this whole time some thousands of backward and forward motions per second, is a hundred times lighter than a steam-engine capable of producing an equivalent work.

This is what renders the problem of aërial locomotion so difficult, and, as, Mr. Hirn says, it explains why we can fly in imagination only.—*La Nature.*

Two Remarkable Needles.—The International Exhibition of Needlework, which is to be held at Sydenham in July, 1884, will include, among other curiosities, two things which will not be the least of the attractions of the exhibition. One is the famous needle presented to the Emperor of Germany last year under circumstances worth recalling. The Emperor was visiting the great needle manufactory at Kreuznach, and was desirous of seeing for himself the relative power of machinery compared with skilled hand labour. A bundle of superfine needles was placed before him, 1,000 of which weighed less than half an ounce, and he expressed his astonishment that eyes could be bored in such minute objects. Thereupon the foreman of the boring department asked His Majesty to give him a hair from his beard, and receiving it, he bored an eye in it, threaded it, and handed back to the astonished Emperor this improvised and most peculiar needle. The other curious needle was manufactured at Redditch, and presented to the Queen. It is a sort of miniature Trajan's column. All round it are represented scenes from the Queen's life, executed so minutely that a magnifying glass is required to distinguish them. This needle can be opened, and within it are a number of very fine needles, on which also scenes have been engraved.

HERR NAUSCHAFF has constructed a delicate instrument for registering earth currents. A sensitive galvonometer is enclosed in a case with a clockwork arrangement for moving a photographic plate about eighty mm. per hour. By a total-reflection prism, a ray of light is reflected on to the galvanometer and focussed on the plate. Thus the slightest variations are constantly registered.

AT a recent meeting of the Edinburgh Royal Society, Professor Tait read a paper by Mr. W. F. Petrie, on the old English mile. The old mile was longer than the present, and consisted of 5,000ft. of 13in. It seemed to be identical with the old French mile. The furlong had no connection originally with the mile, which was modified to suit the former.

SCIENTIFIC NEWS.

NOTES about the remarkable sunsets continue to be published, and accounts are beginning to arrive from the more distant parts of the earth. Mr. Ellery, at Melbourne, thinks the gorgeous sunsets are caused by aqueous vapour in certain conditions in the higher regions of the atmosphere, and he predicted wet weather, which followed the peculiar sunsets in November. Mr. J. Birmingham, writing from Tuam says, "Dust clouds driven from the Javan eruptions may be the reflectors of the strange sunlight from beneath the horizon; but I should rather seek for the agency of ejected gases lighter than our air, such as hydrogen now settled high above the earth." This hydrogen might have been provided by a gaseous comet or meteor stream, and he hopes that no oxygen comet will follow suit in striking us, or there may be a new deluge. It may be mentioned that in 1783 somewhat similar phenomena were witnessed in Europe, Asia, and parts of America, and White in his "Selborne" speaks of the sun at noon looking as blank as a clouded moon, and shedding a rose-coloured ferruginous light on the ground, being particularly lurid and blood-coloured at rising and setting. In most of the accounts the phenomena are attributed to a dry fog or haze. Prof. Brooks, while comet sweeping on November 28, observed a shower of telescopic meteors near the place of the sun.

Of the fourteen circum-polar expeditions eleven have safely returned. The Russian at the mouth of the Lena, and the Finnish at Sodankyla, will be continued for another winter, while the fate of the American expedition to Lady Franklin Bay is unknown.

The death is announced of M. Yvon Villarceau, one of the staff of the Paris Observatory, and an eminent French mathematician.

Mr. Richard Talling, a well-known student of English mineralogy, committed suicide in a fit of temporary insanity at Lostwithiel. He was in his 60th year.

Prof. Owen is to be made a K.C.B.

Last week, Prof. Chrystal and Mr. J. Murray made the ascent of Ben Nevis, and remained for the night at the observatory. Up to an altitude of 2,600ft. they found the road in good condition and practicable for horses, but above that point it had been carried away in parts by landslips, and above 3,000ft was more or less covered with snowdrift. On the summit, which was covered with snow to about the level of the roof of the observatory, they found a blue sky and clear sunshine; beneath the sun the sky was bronze or copper colour, but just above the horizon it had a peculiar pale green tinge. During the night the sky was cloudless, and the temperature was 32-36° Fahr. Mr. Omond reports the weather at the time as the best they had experienced, for on Dec. 12 they were unable to get out of the Observatory for several hours. The "Brocken spectre" is frequently seen on clouds in the valley to the north-east. The Observatory building is described as most comfortable.

It having been decided to republish the papers of the late Prosector of the Zoological Society, W. A. Forbes, as a memorial volume, Professor Sclater will undertake the editorship; Mr. H. H. Johnston will prepare a biographical notice, and Mr. Bell will act as secretary and treasurer of the committee.

Notice has been given by the British Electric Light Company that they have petitioned the Judicial Committee of the Privy Council for a prolongation of the Gramme patent, which was granted to Z. T. Gramme and E. L. C. D'Ivernois, on June 9, 1870. Notice of opposition must be given on or before the 1st of March next.

The Tilghman Sandblast Company have also given a similar notice.

In a paper read recently before the Royal Society Prof. Hughes gives an account of some experimental researches made with a magnetic balance, from which he concludes that we can find the electric conductivity of iron or steel from a simple reading of its magnetic capacity. Thus the best Swedish charcoal iron annealed has a magnetic capacity of 525, while that of crucible cast steel annealed is represented by 84. The electrical resistance of the same is respectively represented by 192 and 350.

A "Syndical Chamber of Electrical Workmen" has been formed in Paris to promote the technical training of the artisans engaged in what may be termed the electrical branches of industry.

The examiner of applications for patents in the United States has rejected nearly all those which, since the adoption of the new "standard" time, have been presented with the idea of securing a monopoly of watch and clock dials with figures arranged to show the twenty-four hours in a convenient way. It appears that an old record exists, in which it is stated that Prince Soltykoff possessed a watch made in 1547, which contained the 24 hours arranged in concentric circles.

M. Bert has presented a note to the Paris Academy of Sciences, in which are described further experiments by M. Bloch, to determine the rapidity of visual and other perceptions. Vision is the most rapid; hearing occupied 1-72nd of a second longer, whilst the sensation of touch required 1-21st of a second longer for transmission than a visual perception.

A conference of science teachers, under the auspices of the National Association of Science and Art Teachers, was held at the Technical School, Manchester, on Saturday, 22nd December. Professor H. E. Roscoe, F.R.S., was in the chair, and the various branches of the Association were well represented by delegates from Liverpool, Birmingham, Newcastle-on-Tyne, &c., &c. After the transaction of routine business, the secretary (Mr. W. E. Crowther) called upon Dr. Henry Evers (Newcastle) to read a paper concerning the expenditure of the Science and Art Department; and Mr. Wm. John Grey (Newcastle) afterwards read a report on the Examinations in Inorganic Chemistry. The delegates were then entertained at tea, and during the evening Professors Roscoe and Boyd-Dawkins delivered addresses, and Mr. Grey gave a science lesson on Nitrogen and its Second Oxide. Professor W. A. Tilden was among those representing the Birmingham branch.

The Bacillus of Phthisis.—M. Vignal has been trying some experiments with the view of ascertaining whether the sputa of phthisical patients as found in the streets still contained bacilli. He collected a certain quantity of such sputa and submitted it to desiccation; he then moistened it and let it dry again at different times, so as to place it as much as possible in the condition in which it would be found in ordinary circumstances in a room. He discovered that the sputa thus treated contained bacilli as numerous and as well-formed as if they had just been expectorated. He inoculated two guinea-pigs with the matter; one of which died in a few days from obstruction in the bowels, and he could not, in consequence, come to any conclusion; but the second animal, though it increased in weight during the first few weeks subsequent to the injection, afterwards began to lose flesh, and died in about three months. At the autopsy it was found that in all the organs there was a great number of tubercles which contained bacilli. M. Vignal concludes that sputa of phthisical patients, as found on the ground in the streets or in apartments, are far from being inoffensive, and might become agents of contagion to persons predisposed, or in whom the bacilli would find a favourable soil for propagation.—*Lancet*.

Plant Life.—It has been shown by Professor Schubeler, a Norwegian plant-geographer, that most plants in high latitudes produce much larger and heavier seeds than in warmer regions nearer the equator. This effect he attributes to the prolonged influence of sunlight during the long summer days of the high latitudes. The difference of seed development was very remarkable in some cases. Dwarf beans taken from Christiania to Drontheim—less than four degrees further north—gained more than 60 per cent. in weight, and thyme from Lyons, when planted at Drontheim, showed a gain of 71 per cent. The grain of northern fields is heavier than when grown in more southerly localities, and seed from Norway planted at Breslau decreased greatly in the first year. The leaves also of most plants are larger and more deeply coloured in higher latitudes, as was first noticed by Griesbach and Martins. The same is true of flowers, and many which are white in the southern climates become violet in the far north. While on this subject of the changes in flowers, it may be mentioned that a "chameleon sort of flower which grows in the United States is white in the morning and red at night. It has been named the Confederate rose, on account of its blending these two beautiful colours. The plant is odourless, it grows in great bunches, and is susceptible of a high degree of cultivation.—*Times*.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

A PUFF BY A PRESIDENT—FOCAL ADJUSTMENT OF A TRANSIT INSTRUMENT—LUNAR PHOTOGRAPHY—LONG-FOCUS TELESCOPES—THE NEW BRUSSELS OBSERVATORY—SOLAR PARALLAX FROM THE LAST TRANSIT OF VENUS—LIGHTNING CONDUCTORS—RAIN-GAUGE—SUN-SPOTS VISIBLE TO THE NAKED EYE.

[22188.]—I COULD not help laughing—in common, I believe, with every one else who is at all behind the scenes—at a couple of paragraphs in the address delivered on St. Andrew's Day to the Royal Society by its President. I mean those having reference to the expedition to observe the eclipse of May 6 last. "In December last," said Professor Huxley, "the President received from the Lords of the Treasury a letter, addressed to their lordships by the Lords of the Committee of the Privy Council on Education, recommending to the favourable consideration of the Treasury a memorial from the Solar Physics Committee, suggesting the organisation of an expedition for the purpose of making observations during the solar eclipse of May 6, 1883; and the President was requested to communicate his views upon the subject to the Treasury. After careful consideration, the President and Council reported in favour of the projected expedition; but they added that they did so *on condition of its being possible to find someone, whose position in the scientific world would command the confidence of the public, to take charge of the expedition* (the italics are mine). Unfortunately, for one reason or another, none of the men of science who fulfilled this condition were able to go; and at the meeting of Council of January 18, the projected expedition was abandoned. The President was, however, requested to place himself in communication with the American authorities, and to ascertain from them whether a photographer and assistant could be allowed to accompany their expedition to Caroline Island. On doing so, he at once received an invitation for two observers, who were accordingly sent out, their expenses being defrayed, partly by a contribution from the Government grant, and partly by a special sum of £500 provided by the Treasury." Unless Mr. Huxley is a much less astute person than the world gives him credit for being, how he must have laughed in his sleeve as he read the words which I have italicised above! Why, C'est le secret de Polichinelle, that the original memorial of the "Solar Physics Committee" was presented in the full hope and belief that one of its own members would have been sent out, and that it was only when the "Department" refused point-blank to suffer a man who was receiving public pay for specific work to leave his post, that any hitch arose at all. Few Fellows of the Royal Astronomical Society will have forgotten the ridiculous and contemptible exhibition made at the meeting of December 8, 1882 (ENGLISH MECHANIC, Vol. XXXVI. p. 334), nor that when a gentleman whose knowledge of Solar Physics and of the phenomena of Eclipses generally is unsurpassed in this country, *did* volunteer to go out, he was snubbed by the persons professedly anxious to secure efficient observation of the phenomena. It is notorious that his opposition to the jobbing little Ring at Brompton was the sole cause of his application being refused. Either, then, Mr. Huxley knows all about this, and must be thoroughly aware that the gentleman to whom I have referred would have enjoyed the entire confidence of the British *Astronomical* public—in which case I would rather not trust myself to say what I think of the Professor's method of lending himself to the glorification of the Brompton Ring—or he is ignorant of the story, and was only repeating a South Kensington lesson like a parrot; in which alternative the value of his utterances on this subject needs no Solon to

AFTERGLOW.

[22195.]—Among the flood of letters written during the last few weeks about the curious *afterglow*, I have not seen one which alludes to the strange phenomenon being visible at midday, as has often been the case here; in fact, on *any* day when that part of the sky near the sun was free from cloud. On the 1st December, an astronomical friend and myself noticed it very distinctly, and it was still more marked on the 16th, when it presented the appearance of a beautifully delicate rosy halo, the inner edge of which seemed to be about 5° from the sun, the *glow* extending some 20° to 25° outwards. **T. E. Clapham.**

Austwick Hall, West Yorkshire.

SYSTEMATIC STUDY OF SELENOGRAPHY — FRACASTORIUS AND NEIGHBOURHOOD—AN APPEAL.

[22196.]—The large number of our readers who are interested in selenographical matters will be pleased to hear that a goodly number of members of the Liverpool Astronomical Society have combined to make a systematic study of this interesting formation and its neighbourhood, acting on a valuable suggestion by your esteemed correspondent, Mr. Elger. We have adopted the following plan of operations. In the first place, we shall endeavour to obtain a correct outline of Fracastorius itself, showing the position of the valleys which intersect the S. wall, also the depressions on the E. and W. walls; and further, to describe, and if possible to delineate, the interesting details on and about the N. border. This done, we shall endeavour, in the second place, to carefully draw the principal objects outside the limits of Fracastorius from "Rosse" and "Beaumont" on the N. to "Piccolomini" *e f* and A, and Fracastorius *c* and A on the S.; also for about an equal distance towards Santbeck on the W., and Polybius A on the E.

The object aimed at, and which will be accomplished if the work is carefully done, is to secure a number of objects to which the craterlets and other features on the interior of Fracastorius may be referred by the method of alignment.

This plan, especially as regards the first part of it, provides work eminently suitable for the employment of telescopes of small apertures, say, 2½in. to 3½in. or 4in.; and my principal reason for intruding upon valuable space is to heartily invite the co-operation of those of your readers who, possessing such telescopes, are at a loss as to the direction in which to turn them to accomplish really useful work. The opportunity is a splendid one, and I shall be pleased to hear from any who can see their way to assist us. We hope before long, with our Editor's kind permission, to publish in these pages such results as we have been able to arrive at.

As regards the interior of Fracastorius, the minute details of its surface are such as can only be satisfactorily studied with telescopes of larger aperture; and this section of the work we propose reserving for the future. **W. Goodacre.**

Clova-road, Forest Gate, E., Dec. 25.

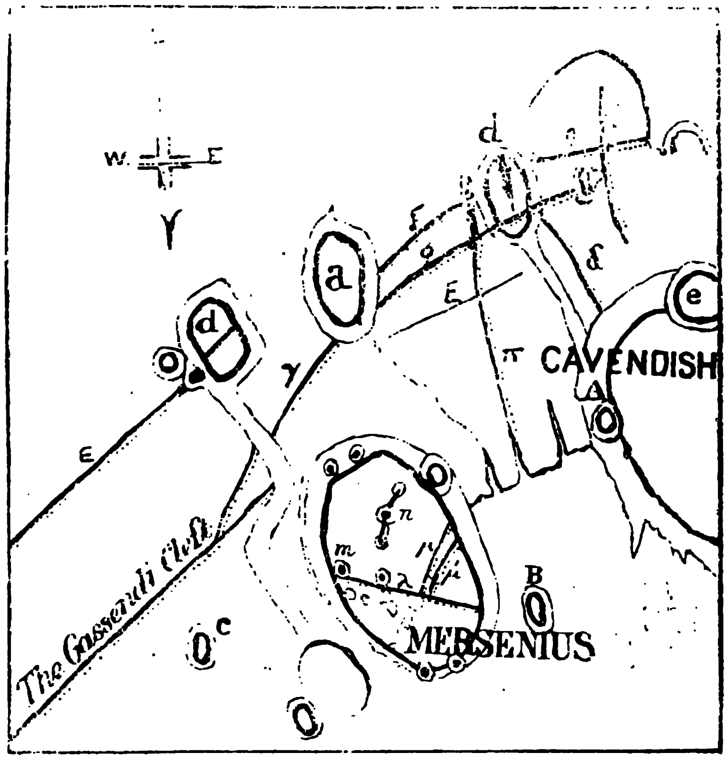
P.S.—To those who would like to join the Liverpool Astronomical Society, I may mention that our secretary is—

Mr. W. H. Davies, 55, Great Newton-street,
Liverpool,

who will be doubtless pleased to hear from such.

SELENOGRAPHICAL — THE CAVENDISH RILL-SYSTEM—CLEFTS ON THE FLOOR OF MERSENIUS—FRACASTORIUS.

[22197.]—The accompanying diagram shows the clefts seen in the region south of Mersenius and Cavendish on November 11th and 12th with a power of 400 on an 8½in. mirror, the definition on both evenings being very good. With a few exceptions it agrees fairly with Neison's map of the district, to which I will briefly refer. A well-marked cleft, δ, was traced from the N.E. side of Cavendish *d* to the S.W. border of Cavendish, which does not appear in Neison's map, and is also omitted by Schmidt. On the west side of the same ring-plain, *d*, is a very distinct row of confluent craterlets lying at the foot of the wall, and crossing clefts ξ and ϕ, which is clearly shown by Neison, and in part by Schmidt. At 10h. on November 11th a fine cleft was seen to extend from the N. termination of this row to a point about midway between Mersenius and Cavendish. It is marked π in my diagram. Neison draws a cleft running in a N.E. direction from the north side of Mersenius *a* to a point rather nearer Mersenius than the N. end of π, but I was unable to see it, though a ridge, occupying nearly the same position, was a prominent object. Neison's cleft ξ appears to be a ridge, and not a true cleft. The crater-row and cleft which traverses Cavendish *d* and extends in a northerly direction nearly to cleft ϕ, where the latter crosses the floor, was a noteworthy feature.



Mersenius.—In Dr. Klein's "Anleitung zur Durchmusterung des Himmels" (a book, by the way, very similar in plan to Prebendary Webb's invaluable "Celestial Objects") is a copy of the fine drawing of Mersenius by Schmidt, in which two short parallel clefts are shown running in a westerly direction from the inner slope of the E. wall. On November 11th both these objects, marked μ μ', were well seen and traced more than halfway across the floor; μ, however, was the easier of the two. On the following night, November 12th, 9h. to 9h. 30m., another delicate cleft, λ, was visible, extending from craterlet *m* to to the N.E. border in a direction which, if prolonged, would intersect Mersenius B. On the N. side of λ is a row of hillocks. These clefts, together with that which appears to connect the central row of craterlets, discovered by Mr. Gaudibert, probably form a connected system.

Fracastorius.—In reference to Mr. S. Maitland Baird Gemmill's observations (letter 22121) of this formation, I should like to know if he saw the bright object C as a craterlet on November 18th? I invariably find it very difficult to see as such with my 8½in. reflector, though in times past it seems to have been visible as a prominent crater. **Thos. Gwyn Elger.**

Kempston, Bedford, Dec. 20, 1883.

SELENOGRAPHICAL—ALPHONSUS.

[22198.]—On p. 339 Mr. Gaudibert asks, What has been observed by others in the dark patches on the floor of Alphonsus? He mentions having seen a whitish craterlet in the centre of the triangular patch on the E. of the floor. This craterlet has been seen by Dr. Klein for some years, and forms the subject of a paper on the volcanic formations of the moon in "Petermann's Mittheilungen" in 1882, and was translated in the *Observatory* of that year. The paper is illustrated by a sketch of the dark patch *p*, and the floor and border of Alphonsus around it, and there is a full description of the details observed. Dr. Klein considers the crater cone, which he calls A, to be one of a few instances of recent volcanic action on the moon, and that the dark matter flowed out from it in a fluid state, and spread itself in a thin layer over the ground around. The other instances of similar crater cones are surrounded by a ring of smoky grey material, which Dr. Klein supposes to become bleached in time, forming the so-called "light-surrounded craters." If Mr. Gaudibert can refer to this paper of Dr. Klein's, he will find a full account of all that that observer has seen in this patch. The round patch on the S.W. is not mentioned by Dr. Klein. I have seen nothing in this patch; but the crater cone A in the patch *p* I have seen well, together with a minute craterlet on the N.W. edge of the patch. The patch has not always appeared triangular to me.

On p. 322, letter 22122, for "craters N. of Theophilus, shown by Mr. Neison," read "*not* shown by Mr. Neison." **M. A.**

CONTINUOUS BRAKES.

[22199.]—"Traffic" (letter 22148) seems to have put a construction upon my letter, on page 323, I by no means intended. When I said, "the amount of stopping power stored up by the train is proportional to the velocity," I did not mean this to be considered with mathematical accuracy, but only that "the greater the velocity, the greater the power," of course, within certain limits. In this, I think, "Traffic" will agree with me. The limit, of course, is theoretically atmosphere pressure; but practically a pressure of about 12lb. per square inch. I merely mentioned the G.W.R. vacuum brake as a case of a continuous brake in general use, the stopping power of which depends upon the speed, and in this case at least, I was right in stating that the application was not satisfactory. I did not mention the ejectors, because, if the trains stop at least 1½ minutes at a station, the brake leaks off by itself.

"Traffic" seems to think that I am trying to disparage the Parker-Smith brake. My opinion on this point is to give the brake a fair trial to see what it can do. In my letter I have merely stated objections to mechanical brakes, which have already been discovered in their practical working. These letters were written chiefly because "Imprimatur" did his best to disparage the Westinghouse brake, when running against the facts of the case.

As to vacuum brakes, *impartial* engineers have condemned them, not only on account of their want of power, but chiefly *because they cannot be relied upon to act when required.* **Meteor.**

ELECTRIC MOTOR FOR MODEL LAUNCH.

[22200.]—In the Strand, in the window of an optician (Apps, I think), I saw lately a neat model launch, whose propeller was connected by a thin rubber belt with a tiny motor set on deck just over the stern like a small cannon—occupying next to no space on the vessel—and connected by a couple of wires with a small battery placed amidships in the hold, the battery circular top being level with the deck. On return to school, my rough sketch on blackboard of what I had seen seemed to give such an evident thrill of pleasure to my pupils that I felt the time taken from "Mr. Feeder, B.A.'s" operation of grinding away at "pello, pepuli, pulsum, pellere" was well spent, and the only regret was that the mechanism having been so small, and my own vision not double-magnifying, I could not give the working details of the engine, and so gratify the curiosity of the more ingenious of the young fellows. Would some correspondent versed in those matters gratify teachers and parents of little boys all eager to be practical, by rather minute details as to how to construct a concern of this sort, in the same painstaking way (but not necessarily at so great length) as has been done in these ever-interesting pages in the case of the lathe, model steam engine, blowpipe analysis, electric bell, microscope, photography. Messrs. Bottone, Sutcliffe, Goold, or "Nun. Dor." are, any of them, I feel sure, competent to initiate, little by little, such docile but dull duffers as myself. If, in Mr. Sutcliffe's sketch, p. 113, No. 967, two more arms were given to the revolving magnet, could their cross-piece cross or be welded into the darkened cross-piece already in sketch? I have seldom felt so exquisite an intellectual pleasure as when I read Mr. Bottone's clear description of "Pacinotti's Ring Armature Dynamo," p. 188, No. 971: (yes. I must confess. I've been lending over and over the "E. M.," containing the article, to some score of pupils by way of a treat, and in compassion for their dreary toiling at ablative absolute, iambuses and trochees, metaphors and similes, discount, stocks, and the usual staple of modern high-class schooling). I could wind the wire on magnets and ring, use files, heat and hammer iron rods in a small way, but those "prolongations" look formidable, and would not iron or brass radial arms interfere with the electricity generated in the ring?

I hope some correspondent will kindly forward detailed description, and show step by step how to fit up on a small scale, devices and apparatus of such profound interest at the present day.

A Big Bairn.

CONCERNING LOCOMOTIVES — TO "HISTORIAN," MR. STRETTON, AND OTHER RAILWAY MEN.

[illegible]—ABSENCE from home has prevented me replying earlier to the letters of "Historian" and Mr. Stretton, contents of which I carefully note. I have devoted some time to looking over Vol. XXVI., to which Mr. Luis kindly referred me some time ago, and at page 170 of that volume I find very full dimensions of a Midland express engine given by Mr. Stretton, who said that the engine could take 15 carriages on a level at 60 miles per hour. Allowing [illegible]tons for engine and tender, the total weight of the train was 210tons, and the total resistance was [illegible]lb. This resistance was overcome through [illegible]ft. per minute; so the number of units of work done in that time was [illegible] and dividing this by 33,000 we get [illegible] as the actual horse-power of the engine. Again the driving wheels were 7ft. in diameter, and must have made 4 revolutions per second, which corresponds to [illegible] strokes a minute. The stroke was [illegible]in., which gives 1,640ft. per minute as the speed of the piston. The diameter of the cylinders was [illegible]in., and piston area, therefore, 255 square inches. Taking the average pressure in the cylinders as [illegible]lb., we get pressure on piston [illegible], and work per minute in each cylinder [illegible]lb., whence the h.p. comes out as [illegible], which agrees very closely with the other calculation. I particularly wish to have the opinions of our railway correspondents as to these figures, because there seems so much uncertainty as to the actual horse-power of loco. engines. I have asked many persons likely to know, and have received very various replies; but in no case was the power [illegible] even approximately equal to the above results. I do not forget that Mr. Luis said (page [illegible] last volume) that it is not [illegible] mode of expressing the power of [illegible] engine; but what I want to know is: Are the above figures correct?—and [illegible] usual or the reverse. It is interesting to notice that the piston speed given [illegible] exactly the same as that suggested [illegible]. I have not yet had time to [illegible] Mr. [illegible]'s letter, but as far as I [illegible] it seems to be in disagreement with "Historian's" statement as to the impossibility of [illegible] the speed of an engine.

Wm John Grey.

[illegible]

THE LIGHT OF OTHER DAYS.

[illegible]—[illegible] light occupies a definite [illegible] together with the [illegible] vast distances [illegible] before it reaches our [illegible] which we can see, [illegible] quite fanciful, [illegible] domain of the [illegible] at least conceivable that [illegible] may be endowed with [illegible] greater than anything [illegible] may be possessed [illegible] as we can have [illegible] possible for them [illegible] detail at distances [illegible] imperceptible by our [illegible] the existence of any [illegible] by the light which [illegible] we know that it is [illegible] of them may have been [illegible] at some time prior to the [illegible] have their exist[illegible] hand, others which [illegible] within reach [illegible] not yet reached [illegible] shot fired from a [illegible] we have of the [illegible] really see, not at [illegible] subsequent [illegible] facts to compare, [illegible] longer interval of [illegible] the full in[illegible] which we had seen. And by the time this knowledge was *present* to *us*, it would have been a thing of *some time past* to the person who fired the shot. Now, taking this idea in conjunction with that which I before mentioned—namely, the possibility of other beings possessing powers of vision capable of minute observation as far as light can reach, the strange thought is suggested that to such beings occurrences on this or other worlds which have long since been past and gone, and perhaps forgotten, may at the present, or at a still future time, be present to their sight as *actually happening in the present*. Supposing *we* were endowed with such form of vision, and that we were able to travel unfettered by space, we should, for instance, only have to retire to the respectable distance of "α Aurigæ," whence light would require some 70 years (*vide* p. 310) to travel in order to become *actual spectators* of, say, the Battle of Waterloo. Of course, we know that, according to the laws with which we are acquainted, the light of this earth would not be visible from "α Aurigæ"; but who can say but that under conditions with which we are *not* acquainted it *might* be?

J. H. C.

MICROSCOPIC TEST OBJECTS.

[22203.]—IN reply to "Monachus" (22151), I began to realise the uselessness of oblique light for the determination of true structure during a lengthened examination of a Nobert's 19 band plate. I was much struck by the appearance of a single line of the 1st band, when viewed by an oil imm. $\frac{1}{25}$ N.A. 1·25, illuminated by a large angled cone of direct light. The groove, which the diamond had ploughed in the glass, was most distinctly seen, and along the sides of the groove there were places where the chips of glass had flown off. With oblique light all this was lost; the line appeared as if it had been painted on the surface of the glass. This showed me that if definition was wanted direct light must be used.

I do not intend for one moment to affirm that a higher band of Nobert can be resolved by direct than by oblique light: but this I do say, that the ultimate structure of a diatom can only be demonstrated by direct light.

No microscopist in the present day would uphold the theory that the ultimate resolution of the P. angulatum was six sets of lines or grooves, inclined at an angle of 60° to one another. But a similar view of it was held in Quekett's time, for in the frontispiece of his book there is a beautiful engraving of it, exhibiting diamond-shaped marks all over it; a false conclusion, the result of oblique light. Neither will anyone insist that the ultimate resolution of the N. Rhomboides is represented by two sets of lines, at right angles to one another, a picture produced by the employment of two beams of oblique light, Fig. 1. In the days of Griffith and Henfrey they got beyond that, and dotted the Rhomboides, Fig. 2.

Fig. 1

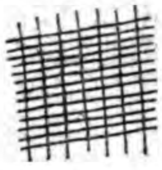


Fig. 2.

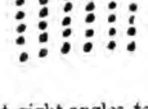
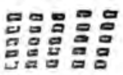


Fig. 3.



It is quite natural to expect that with the increase of aperture and the improvement in objectives there should be simultaneously a development in the resolution of the diatoms. One misses too, with oblique light, all that beautiful tracery inside the hexagonal areolation of the coscinodisci, which can only be seen by direct light; for with oblique light the blur of the hexagonal structure blots out the fine markings. When we come to the very finely-marked diatoms, such as a Pellucida and some of the Nitzschiæ, we must be content with lines, by oblique light, until we can get sufficient aperture to enable us to see the ultimate structure.

I will now close by giving a sketch of the development of the resolution of N. Rhomboides.

Dec. 28. **Edward M. Nelson.**

[22204.]—THERE is an additional point in Mr. Nelson's letter (No. 22134) which is no less puzzling than his other statements; but which your correspondent "Monachus" does not notice.

Mr. Nelson considers it absurd to test an object-glass by oblique light, as thereby the central part of the object-glass is not used—"it might as well be stopped off altogether."

This involves one of the most curious *petitiones principii* that I remember to have seen in microscopic matters. The answer to Mr. Nelson, of course, is, that the method we pursue in testing a thing is necessarily entirely decided by the purpose to which it is intended to be put. If we are concerned with a cannon or a racehorse, we test the one in relation to its power of resisting the tendency to burst, and the other to its power of speed: but we don't reverse the process, because we don't require the horse for any service in which it will be liable to be burst, nor the cannon for any in which it will have any temptation to run away.

So with the object-glass which we are intending to use for the examination of the diatoms mentioned by Mr. Nelson. For their resolution it is the marginal part of the object-glass which alone is used. The centre is unused, and might as well be stopped out: a conclusion similar in words to that of Mr. Nelson; but otherwise very different.

The origin of Mr. Nelson's mistake is simply that he has failed to grasp the action of those diffraction spectra of which he writes. If he will follow out that subject, he will not engage himself in future in the useless task of testing what "might as well be stopped off altogether."

T. T.

MICROSCOPIC MOUNTING.—VI.

Chloroform—Vegetable Objects.

[22205.]—1. *Chloroform or Benzol for Thinning Canada Balsam.*—In the first place, I have very heartily to thank Mr. Wright for his criticisms: for work can be done and methods brought out only by interchange of ideas. Balfour ("Manual of Botany," p. 784) prefers benzol. The chloroform solution has been in use for nearly fifty years, I believe; it is commended by Frey, in his work "The Microscope," and by Beale, in "How to work with the Microscope," p. 57 (Beale also mentions the benzol solution, p. 90); and Carpenter mentions both, without giving the preference to either. I am informed that in chloroform and C.B. many of old Mr. Topping's best slides were mounted, and I do not remember to have previously seen or heard that it produces spottiness, of which, again, I have no personal experience, though I have mounted more than two hundred slides in this way within the last eight years. By spottiness, I presume Mr. Wright means disintegration or break of continuity of the Canada balsam which remains after the media used with it have evaporated. In a slide of *Surirella gemma*, mounted by I. D. Möller in phosphorus, which I got some little time ago, a cavity has appeared among the objects near the centre of the slide. In another, of *Arachnoidiscus Ehrenbergii*, the same thing happened under one of the objects while I was examining the slide; the speck disappeared on applying warmth. The truth seems to be that whenever there is under the cover, along with the object, a mixture of several substances, some of which evaporate, while the rest solidify, the escape of the volatile ingredients is liable to leave interspaces. Even if simple Canada balsam is employed, the same thing *may* perhaps happen, as its turpentinous part will in time escape. It must be more likely when there are only scattered particles of balsam, though the space beneath the cover be filled with liquid, as if too weak a solution of the balsam were used; and more likely again if the object is sopped with turpentine, oil of cloves, of cajeput, lemons, &c., in being mounted, so that there is scarcely any balsam in its immediate vicinity. I believe, then, that the best resinous mounting is balsam as stiff as the object will stand, and as can be managed without air-bubbles; that as little turpentine as possible or other fluid in which the object has lain should be introduced with it into the balsam, and that as much as possible of what is introduced should be allowed to evaporate before putting on the cover. But if the object is too delicate to be thus treated, some solvent must be employed; and on the above principles I believe that the great point is not to make the solution too weak, and to allow the solvent partly to evaporate before covering. The greater volatility of chloroform is here, of course, distinctly advantageous. But I admit that the evaporation may be inconveniently rapid when complicated objects, such as an insect or the head of a blowfly, have to be arranged on the slide. A skin may form over them, and entangle delicate parts, so that, e.g., the antennæ may be broken. But touching the part which it is required to move, with a minimal quantity of chloroform, or turpentine, releases it, while the other parts remain fixed. However, this would not be so likely to happen with benzol, a smaller quantity of which, moreover, it is my impression from experience of seven years or so ago, renders a larger amount of balsam of an oily or creamy consistency. The rate of evaporation, moreover, does not depend solely on the solvent employed, but balsam solutions harden more rapidly in proportion to the hardness of the balsam from which they are made. The plan recommended by Beale for benzol (which is the most detailed I have met with) is to bake the balsam in an oven below 200° Fahr. till it becomes chippy. Stiff Canada balsam is useful for very many purposes; hence I recommended balsam to be bought in a corked bottle, in which it stiffens more rapidly. To make the chloroform solution I let it stay there till it retains the same position when the bottle is slanted or inverted, which is a less violent method than baking it. I then dissolve it in chloroform (not methylated chloroform), and keep the solution in a stoppered bottle for use.

I have taken for granted that by spottiness Mr. Wright does not mean the milkiness or dirtiness which appears in objects where the water has not been well taken off by spirit, or the spirit by turpentine, benzol, oil of cloves, cajeput, lemons, bergamot, or some other "bridge." Both water and alcohol render Canada balsam milky, so that the object should remain a day or two in spirit to remove the bulk of the water, or for a longer time if bulky or containing cavities or tubes. It has remained long enough in turpentine or benzol when it "clears," a change easily recognised in most specimens after it has been seen in a few, and consisting in greater transparency and hardness, and smaller flexibility. If allowed to remain too long, therefore, objects become unmanageable and brittle; they may also contract and tear, or curl from contracting more on one side than the other. The only thing is to remove them before these detriments have occurred. In oil of cajeput an object need continue only a couple of hours or less, and, with oil of cloves, a few minutes suffices, the spirit and water evaporating from the upper surface of the section while the oil penetrates from beneath. I have also supposed that air bubbles are not referred to. Canada balsam and its solutions contract in proportion to thinness, so that after a longer or shorter time a space is left at the edge, between the slip and the cover. This is easily filled up by slanting the slide and putting a drop of Canada balsam, or a solution of it, close to the edge. It runs down and fills up the space. The process has to be repeated as long as evaporation and contraction perceptibly go on, after which a ring of Canada balsam and chloroform (or, if the reader prefers it, benzol) may be laid on at the edge of the cover, the slide having previously been cleaned. Finally, as Canada balsam becomes brittle with age, a ring of goldsize may be added. In all this, I have been speaking of the preparation of the ordinary small microscope slides; I have no experience as to larger ones often sold for the magic lantern. I ought to add that the milkiness (which appears as soon as the water or spirit have had time to escape from the recesses where they lurk) often vanishes with time and warmth, and that the contraction is greater with large covering glasses. It must be more dangerous in proportion as the cover is nearer the slip.

II. *Non-fructifying Organs of Higher Plants.*—In the last two letters I have described the process of cutting sections by hand and the action of the common chemicals or reagents. Both of these are employed, both on animal and on vegetable preparations. I will now take up the preparation of vegetable objects in particular, which form a considerable and important part of a microscopical cabinet. The most difficult vegetable and animal preparations, as a rule, are those by which the lower divisions of the two kingdoms, and the embryology or early development of plants and animals, are attempted to be illustrated. It is best, therefore, to start with the higher plants, about which, again, most of us have already a larger amount of pre-existing knowledge to help us in further investigations, rather than with the lower, where the tissues and organs, if they exist at all, are very delicate and minute, and present only in an inchoate and imperfectly formed condition.

By non-fructifying organs are here meant leaves, petioles, or leaf stalks, stems (including branches and twigs), with scales, hairs, and any other appendages they may possess, and roots, with tubers, &c. With stems are to be counted rootstocks, which are underground or almost underground stems. The primary organs are the leaves, which are cakes or expansions of cellular, pithy, or fundamental tissue, so-called because it is the only kind of tissue found in very lowly plants, and because the other kinds are modifications of it. It forms the pulp of the leaf, green towards the outside, but often little coloured internally. It is covered in aërial leaves, as distinguished from those whose surfaces are immersed in water, by covering tissue consisting of epidermis coated by a sort of glaze of cuticle, and is strengthened and supported by the so-called veins, which consist of fibres and vessels, and not only strengthen, but help to maintain, the circulation of juices in the plant. The bundles of fibres and vessels arrange themselves more or less symmetrically at the base of the leaf, proceed down the leaf-stalk, which may be regarded as an unfolded part of the leaf, re-arrange themselves on entering the stem, which may again be viewed as a compaction of leaf stalks, and from the trunk or ascending axis pass into the root or descending axis of the plant, where they are redistributed among its branches and twigs, till it at last ends in delicate cellular tissue similar to that of the leaf.

These and other points may best be illustrated in the first instance by dicotyledons, where they are very symmetrically exhibited. The following examples are easily procured and identified:—Thick leaves, most of which are obtainable at any season: rhododendron, laurel, holly, ivy, begonia. Petioles, soft and thick, some channelled, or with ridges and furrows, others without: celery, carrot, parsley, and most other umbelliferous or hemlock-like plants; fig, mulberry. Annual stems, also soft and thick: sunflower, bean, yarrow, most umbelliferous plants, cabbage. Soft perennial stems: poplar, willow. Roots and tubers: potato, radish, turnip, parsnip, carrot, and umbelliferous roots generally. The structures may then be followed into endogens, then into ferns, and their allies the adder's tongues, horsetails, and club-mosses; and finally pursued into the mosses and liverworts, which are the lowest and least characteristic of the higher, vascular, cormophytic, axial, or leaf, stem, and root plants. The structure of the stem, &c., in gymnosperms resembles that of dicotyledons. The common English gymnosperms are the coniferous or cone-bearing plants—firs, pines, cypresses, yew, the arbor vitæ, &c.—easily distinguished by their foliage, and often containing much resinous matter. For the transport of this to the stem there are conspicuous resin-ducts in the leaves, which render transverse sections of them interesting microscopical objects. The following are easily procurable examples of endogens or monocotyledons:—Valisneria spiralis, anacharis, stratiotes, hydrocharis (all with wholly or partly aquatic leaves, and familiar to aquarium keepers); orchids, the iris, black bryony (a common hedge plant: good root), lilies, tulips, onions, asparagus (a good stem), rushes, sedges, and grasses, including wheat, rye, oats, &c. No English endogens have perennial stems; all our shrubs and trees are exogens; *i.e.*, either gymnosperms or dicotyledons, so that for woody perennial endogens (palms, bananas, dragon tree [specially recommended], lily tree, sarsaparilla, cane), we must be content with dry specimens, or have recourse to a hothouse.

III. *Ways in which Vegetable Sections should be Cut.*—It follows from what has been said that the best places for cutting sections of the above objects are—(1) In the course of the root or stem where no branches or leaves are being given off, and in the course of petiole; and (2) where branches or leaves are separating, and where the petiole and blade of the leaf are passing into each other. The first set exhibit the ordinary lines of rails, as it were. The second, which are often fine polarising sections, help in understanding the construction of the junctions; for which, however, a stem may be steeped till it has begun to macerate, and the bundles then be carefully scraped clean. Heat, or the addition of a little nitric acid to the water, accelerate the process.

The sections must be cut either *exactly* vertically or parallel to the length of the stem, petiole or root, or exactly horizontally or transversely to its length. If this is not attended to, the lumen or aperture of the smaller tubes will not be seen in horizontal sections, or, at least, the section will have a twisted and overlapping appearance; while in perpendicular section tubes or fibres will pass out of sight. Horizontal sections are most instructive for obtaining a general view, and longitudinal, which may be either axial, or through the axis or centre of stems, &c., or tangential—i.e., on one side of it, for examination of details. Oblique sections are useful supplements to combine the horizontal with the longitudinal views.

Stems and the like have been here supposed to stand upright. Leaves, on the other hand, are conceived as lying flat, so that with them a horizontal section is one parallel to the surface of the leaf. This can scarcely be obtained, unless with thick fleshy leaves; but its place is partially supplied by tearing. If a leaf be bent, till it partly breaks, or the epidermis just cut through with a sharp knife and raised a little at the edge—as in cutting a small piece of blotting-paper from a pad—the piece may be taken by its edge between the finger and thumbnail, and torn away from the cellular tissue beneath. This is easy in endogenous plants which have straight-veined leaves; in exogens, whose leaf-veins are forked or netted, it may be difficult. It is, however, facilitated by steeping the leaf in water, or in water with a few drops of nitric acid; or, again, in the nitric acid and chlorate of potash solution. The skin of the other side may be first torn roughly off. The action must not be allowed to go too far; or not only the subjacent cellular tissue, but the epidermis itself, will become unmanageably soft. Adhering pieces of "parenchyma," as cellular tissue is called, may be cautiously scraped off, especially if previously softened by immersion in the nitric acid solution. Their presence, however, is not always objectionable (*e.g.*, in the under side of a begonia leaf), and they do not stand out if bleached. Indeed, the whole thickness of a thin previously-bleached leaf may be mounted. Almost horizontal sections may be secured by shaving a leaf with a razor. Vertical and oblique leaf sections, which are longitudinal if from base to tip, and transverse if across the leaf, may be made by folding a leaf several times, or taking several leaves together, cutting through the whole, and afterwards picking out the best sections; or a piece of carrot may be cut in two, a portion of a leaf inserted, and the whole cut together. Transverse sections of leaves are usually the most instructive. Petals and sepals, which are really leaves, the first of the corolla, or (usually) the coloured leaves of the flower, and the second of the calyx, the (usually, again) green, leaf-like envelope which protects it while in bud may be dealt with in the same ways. Scales, as in ferns, may be simply picked off, dried between slips, steeped and heated on a slip with turpentine to expel the air, and mounted resinously to polarise. Hairs may be taken off with the leaf skin, or their insertion seen in section.

IV. *Bleaching.*—The best staining for a general view of the object is obtained when the sections are cut from perfectly fresh tissue, and immersed in the staining fluid, immediately, or as soon as any tags, &c., which adhere to them have been washed away. Vegetable objects, however, have often a strong colour of their own, which would combine inharmoniously with the stain. Strong solutions of caustic soda ("E. M.," No. 979, p. 367) not only remove or change and diminish the colour, though that of the suber or cork (yellowish-brown) sticks to it obstinately, but have the simply invaluable property of rendering opaque trial sections transparent in a minute or two. All that is necessary is to put a drop of the solution on the section as it lies on a slip; see that the drop thoroughly penetrates it, cover it, and leave it for a moment. It is destroyed as the action proceeds. But a weaker solution, 5 p.c. or so in glycerine, regard being had to any special delicacy of the object, allows of subsequent mounting, if removed by thorough washing with acidulated water, glycerine and water, or glycerine ("E. M.," No. 979, p. 366) before it has produced its full effect. Alcohol and bisulphide of carbon also decolorise. But they do this less perfectly than solution of chlorinated soda, the following recipe for making which is given by Cole in the first volume of his "Studies in Microscopical Science." To a pint of distilled water add 2oz. of chloride of lime. Stir, and shake well, and at once add a saturated solution of washing soda till the mixture becomes thick and turbid. Allow it to settle, pour off the clear part for use, and keep it in a well-stoppered bottle in a dark place. To use it, immerse the sections in it for from six to twelve hours, and afterwards wash them with five or six changes of water in the course of 24 hours. If allowed to remain too long in the chlorinated soda, they will become disintegrated. The solution is alkaline, though not very strongly so, and removes or renders transparent the ordinary contents of the cells, permitting only the cellulose walls to be afterwards seen. I have not tried sulphurous acid solution or chlorine water; but I presume they might also be used for bleaching vegetable sections.

V. *Staining.*—Cole recommends the sections then to be double-stained as follows:—1. Leave them in a mordant for twelve hours or so. The mordant is prepared by mixing one fluid ounce of a 5 p.c. solution of sulphate of alumina with thrice that quantity of a 5 p.c. solution of lead acetate, leaving the mixture to settle, pouring off the clear fluid, and diluting it with four or five parts of (distilled, preferably) water for use, filtering. 2. Then wash the sections, and immerse them in alkaline carmine till well stained. To prepare this the receipt given is 15gr. carmine, the same quantity of strong ammonia, and two fluid ounces of water. Dissolve the carmine in the ammonia with a little water by the aid of heat, and add to the rest of the water, keep in a stoppered bottle, or the ammonia will evaporate, the carmine or carminic acid, which is retained by it in solution, concomitantly precipitating. On account of the varying strength of ammonia, what has practically to be done is to add it till no carmine settles, and then to add a little more.

The next step is to drain off the staining fluid, of which no more than enough to cover the sections, which may be little more than a dessertspoonful, need have been applied. They are directed then to be washed rapidly in dilute nitric acid, thirty drops little apparatus which I call a hand-warmer, and after giving it a thorough trial I have not the slightest hesitation in asserting that I would not be without it for *twenty times* its cost. It consists of a neat oblong lamp or stove, which is adjusted to the front of the keyboard opposite the middle octaves. It burns four small lights, and by using the best kerosine oil no fumes whatever are caused in the room. By thoroughly warming the hands and wrists, it also keeps the whole body at a very comfortable temperature on the coldest day. I can adjust or remove it in a moment; and so far from being any disfigurement, it is quite as ornamental as the brass candlesticks frequently attached to pianos.

The cost of my own was 21s; but the maker informs me that as he has now all the tools and appliances exactly required, and knows precisely how to go to work, he can make others at 12s. 6d. each. **W. Ritchie.**

KEY CHARACTERISTICS IN MUSIC.

[22211.]—I am sorry to divert N. E. Child (letter 22184) from his main issue to what must be, at best, a side subject to him. My discourse did not regard "bird crumbs," but the opening of a hung window, which is fitly enough comparable to the opening of the highest-pitched reeds in the voice harmonium. So also is the lengthening of a reed tongue, which implies alteration of pitch, not unlike the lengthening of a forefinger. N. E. Child's "say," notwithstanding, I *know* that when the reeds are set on end in the voice harmonium the high-pitched ones *give no sound at all*. I live near Fort Matilda, on the Clyde, where soldiers at times practise their exercise with reeds tipped with fire. Every cannon used has a throat, but when it speaks the neighbouring hills, even to a distance of many miles, are as if they were all throat together. The application of this to the matter in hand is brief, and definitely carries my meaning. The voice harmonium, as it is, is not acceptable, and is comparatively useless. Stripped of its keyboard, and hung up in its bones, and only allowed to reply to another pure-tuned instrument played upon, it would be, in a small way, like the Highland hills replying to Fort Matilda's guns.

Gourock, 31st Dec. **George Templeton.**

AMATEUR MUSICAL INSTRUMENT MAKING.—IV.

[22212.]—Having now fixed the position of the two holes F and A (Nos. 1 and 19, see Figs. 5 and 6) near the extremes of the body, we obtain the expected positions of those between them thus:—On a strip of paper, make two marks at 29·6 cent. from each other, representing the above two holes, shift this paper on the geometric scale till it incloses 15 lines between the above, F being thus No. 1 and A being No. 17. This position will be found on the 23in. parallel, placing F on D sharp, and A resting on G natural. The intervening lines are then marked off on the strip, and will represent the various semitones between F and A. To check the accuracy of scale it may now be laid on the 19¼in. parallel, between C and E, which should exactly correspond with the lines or marks already on the strip. We thus get distances correct for holes that gradually decrease in size, and that are ventilated more or less the same as the two we have chosen to start with; but other considerations now arise, such as holes Nos. 6, 8, 10, 12, 15, 16, 17, all require to be covered by the fingers. Nos. 6 and 8 have rings round them, and as it will not do to have small holes alternately with large ones, the other holes must be sometimes modified to be somewhat uniform with them. So that every hole on this instrument is a compromise, the holes not being in their theoretical position at all. To accomplish this would involve alterations of fingering, increasing the number of holes, and the result would be a doubtful advantage. I may remark in passing that the Boehm clarionet does not give so fine a tone as the Albert, and the Albert is not so good as the old instrument with six keys. It thus appears that the number of holes closed by pads are either not kept tight, or that the pads interfere with the tone somewhat. By a large number of keys we gain in facility of execution, and have the instrument in better tune.

"J. J. D." asked, on Aug. 24th, if the holes were placed at nodes. Now, in a tube containing vibrating air a node is a place of no vibration, so that nodes should be between the holes, the centre of a neutral segment being under the sounding hole. Some time ago I drew out carefully the theoretical and actual vibrating segments of a number of tones on this instrument, and found that sometimes a node occurred close to a hole. Generally speaking, in the range from lowest note to C on second ledger line above, the holes are fairly placed, and near the centre of vibration. If a hole is opened at the node of a note sounding, it usually interferes and breaks the tone. For example: if, when lower B natural, 3rd line, is sounding, we open the key No. 19, Fig. 6, no change is perceived, as this key is then at the centre of a neutral segment; but if the octave B natural is sounded, key 19 being then at a node breaks up the note. Also at top E natural the harmonic key No. 21 should not be used, as it is near a node. A hole widened or placed higher allows the point of greatest vibration to shift higher up, the clarionet being usually reckoned as a stopped pipe; the point of the reed is at a node, and the length of its vibratory wave is *four times* the length of the tube when sounding its lowest note. Our clarionet tube being now ready for the metalwork and keys, the next step is to determine where each hole must be, so I now give their position both on the C and B flat instrument, referring at the same time to Fig. 5 and 6 for general place and form. Clarionet makers first bore all the holes on the body, and then put on the keys, &c.; but this cannot be well done by amateurs, the easiest way being to wrap white paper round the body, fastening it with gum, then draw the keys, pillars, and fittings in their proper places, and mark the pillars through the paper with a small point or drill. The paper can then be removed, the pillar holes bored, screwed, and the pillars and keys, &c., fitted to their places on the body. The sounding holes are then marked carefully on the wood of the body by drawing a sharp point round the metal key cups. The keys are then removed, polished, the springs added, and the pads put on. The sounding holes are then bored, roughly tuned, and finished round the edges. The keys are then put on, and the instrument is ready for final tuning and regulating.

To those who are making a clarionet I will give full-sized lithographs of keys and parts, if they advertise their addresses within two months and pay postage. This will save them some drawing, and explain matters clearly, as Figs. 5 and 6 contain a few errors, and are not intended for working drawings. Those who make the body all in one piece, please correct the distances as follows:—

Hole No. 10 place at 29 cent. and bore at 6 mill.
Key No. 11 place at 27 „ „ 5·5 „
for the C clarionet.

Also correct the B flat positions thus:—

Hole No. 10 place at 33·1 cent., and bore 7·6 mill.
Key No. 11 „ 31·2 „ „ 6·6 mill.

Keys of Instrument. See Figs. 5 and 6.	C Clarionet.			B flat Clarionet.		
	Distances from Reed.	Size of holes.	Size of keys.	Distances from Reeds.	Size of holes.	Size of keys.
	Cent.	Mill.	Mill.	Cent.	Mill.	Mill.
21	12·5	2·9	8	14·5	3·0	8
20	14·2	4·5	10	16·3	6·0	10
19	16·3	6·2	11	19·0	7·2	11
18	17·4	4·5	11	20·2	6·5	11
17	18·8	6·6	15	22·0	8·0	15
16	20·8	6 3	—	23·8	7·5	—
15B	21·4	6·0	11	25·0	7·0	11
15	23·1	6·4	—	26·4	7·5	—
{ 14	24·2	4·7	10	27·8	7·5	11
{ 13	24·2	4·7	10	27·8	7·5	11
12	25·8	6·5	—	29·3	8·0	—
11	26·2	4·6	10	30·0	5·0	11
10	29·4	6·5	—	33·5	8·0	—
9	30·6	4·0	10	35·0	5·0	11
8	32·0	7·2	—	37·0	8·5	—
7	33·3	7·0	11	38·0	8·5	15
6	35·0	7·8	—	39·8	9·0	—
5	38·2	10·0	15	43·0	11·0	15
4	40·3	12·0	18	45·8	12·5	18
{ 3	43·0	10·0	15	48·4	12·3	18
{ 2	43·2	10·0	15	48·7	12·3	18
1	46·0	12·5	18	52·0	12·5	18

18th December. **Vulcanite.**

THE MARTINI-HENRY RIFLE ON PICKET AND SENTRY DUTY.

[22213.]—As far as my experience went, sentries and picket guards always kept their rifles loaded (I mean in war time): I presume it is the same in the English service. But how can this be managed with the regulation Martini-Henry, which is always at full-cock when loaded? I understand that on the first introduction of this arm into the British army there was a safety stop to it, which enabled the soldier to carry it safely when loaded, and that this stop was afterwards abolished. Would some of your military readers give us the reasons for this step? For mere firing in line the weapon in question may be well adapted; but that is only one part of a soldier's duty. In wild and wooded countries the scouting soldier should take a leaf from the hunter's and trapper's book, and then, I think, he would find his present gun not the best adapted to his needs.

Last night I had a practical illustration of its unfitness for this sort of warfare. When I left the frontier, soon after the close of the American war, I never expected again to creep along in darkness and rain, rifle in hand, with eyes and ears at their utmost tension to detect an enemy lurking in the brush, and yet this has come to me. One of my tenant's houses having been fired into by Land Leaguers, I patrolled about the place for some time in the night, intending, if the game was attempted again, to try to make these gentry feel in their own persons what they so freely administer to others. Well, I actually was afraid to keep my gun loaded (a regulation Martini-Henry carbine) on account of the defect alluded to. I got two falls, and they showed me plainly enough that a loaded rifle at *full-cock* was not desirable under such circumstances. At last I abandoned the dangerous weapon and trusted to my pistol alone, and everyone knows that is a poor tool except at very close quarters. Next night I shall take a double smooth-bore with buck shot.

By the way, under any circumstances, this is the best arrangement for a dark night; except in very bright moonlight, one can't see the sights of a rifle at night. One thing that struck me at once, is the difficulty of walking on a road without making a noise with the feet. Under ordinary circumstances one would never notice this; but last night the contrast between it and the prairie or the forest was very marked.

December 28. **Ex-Frontierman.**

AN EIGHT-INCH SPARK COIL.

[22214.]—It may reasonably be supposed, from the frequency of recent inquiries, that the interest felt by a large section of our readers in the subject of the construction of induction coils is not exhausted. I, therefore, describe a coil which I have lately completed, and which gives sparks 8in. long, with a battery power of five-pint Grove cells. The general dimensions were based in part upon information gathered from the back volumes of the English Mechanic; but very numerous preliminary experiments were found necessary for the determination of certain points, such as the most favourable distribution of the secondary wire along the core, and the minimum of efficient insulation.

The core is of No. 20 B.W.G. iron wire, of good quality, and was carefully annealed in charcoal. It is 1ft. long, 1¼in. in diameter, and weighs 2lb. 12½oz. The primary is of No. 14 copper B.W.G. single silk covered, wound in three layers upon the covering of silk tape which envelops the core, no insulating material being interposed between the layers of wire. The weight is 3lb., the length about 140ft., and the number of turns 345. The finished primary and core were immersed for several hours in melted paraffin. They are inclosed by an ebonite tube, 14in. long and 3/16ths of an inch thick, having an internal diameter of 2in. The secondary is of three gauges, each single silk covered. It contains 1lb. 7oz. of No. 36 B.W.G. and 6lb. 8oz. of a wire which was purchased as 35 B.W.G., but proved to be a mixture of 35 and 34 in unknown proportions. The total weight is 7lb. 15oz., and the resistance 4,970 ohms. An exact statement of the length can hardly be made; but even if the whole of the nominal 35 were genuine, the total length could not exceed six miles, and, in point of fact, it is probably much less than this. The secondary is wound upon Ritchie's or Apps' method, in 37 vertical compartments, each compartment being 3/16 of an inch wide, and containing, roughly, three ounces of wire coiled to a height of about 1in. from the insulating tube. The winding was begun in the centre, with the number 36, which occupies the exact middle of the primary, and the other sizes were so disposed that the diameter of the conductor increases with as much regularity as was attainable towards the extremities. All the wire was baked, and passed through hot paraffin, in winding, and *the superfluous paraffin was not wiped off*. Each convolution of the secondary is, therefore, imbedded in solid paraffin, and no accidental interstices occur wherein leakage can set up. The discs or partitions are of stout white blotting-paper, baked and steeped in melted paraffin; two thicknesses were placed between each pair of compartments. The diameter of the coil, including its casing of thin sheet ebonite, is about 4⅜in., and the length 9½in. Protection is afforded the ends of the secondary, and any brushing or leakage towards the primary prevented, by thick discs of paraffin wax. Readers who desire fuller details of the mode of coiling the wire, &c., are referred to my communications on page 598 of Vol. XXXV., page 118 of Vol. XXXVI., and page 18 of Vol. XXXVII. of this journal.

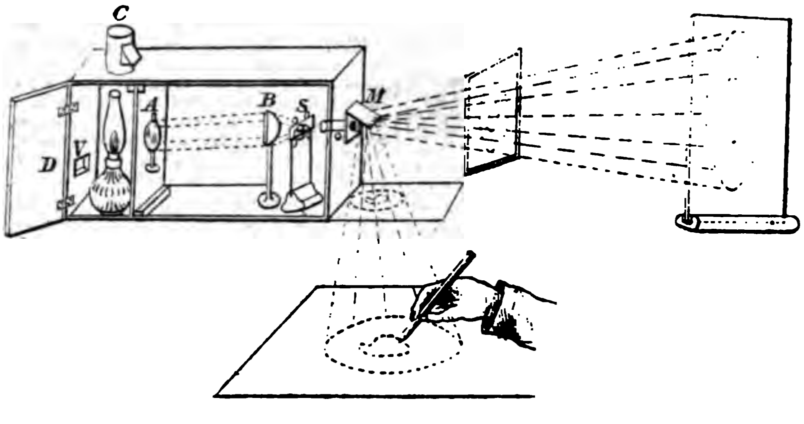
The amount of condenser surface required was arrived at by careful experiments, and the foils were built up to a capacity of half a micro-farad. The contact-breaker is of Apps' patent form, described and illustrated in Vol. II. of Gordon's "Electricity," where it may be studied. One of the greatest difficulties in the construction of a large coil, or of any coil containing a *large core*, is the arrangement of the break in such a way that it can be made to act slowly enough to bring out the full power of the instrument. An interesting

Respecting a cheap drilling machine, though I should be very willing to comply with "W. F.'s" suggestion, let me say that my hands are full for many weeks to come. When, however, the articles for which I am under obligation terminate, I will place my services at the disposal of our indulgent Editor once more. J. M.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[52126.] — **Microscopical.** — Presuming the camera lucida is required, for utility I strongly recommend the following substitute for drawing or enlarging purposes:—I use a box about 21in. by 15in. by 8in., without lid, sideways, on the left-hand side of which I put my lamp, flame edgeways, closed in with a sliding partition, carrying a condenser. This throws the light in parallel rays on a second condenser, near the focus of which I present the object desired. This I advance towards an objective (preferably 1in.) screwed into the inside end of the box. So far, this constitutes an excellent micro-magic lantern. The image can be received on a screen of tracing-paper, amplified as much as loss of light will permit. Just outside the hole which carries the objective I hook on a small piece of looking-glass at an angle of about 50°. It reflects a distinct image in natural colours on a sheet of paper placed on the table. If I want a diagram larger than usual, I simply place my box on a chair on the table. It has the advantage that, in moving the object, you need not touch the optical arrangement. After sketching you may replace the object by a slide, specially made to show a measured scale, and the amplification of the diagram may then be registered. Of course, the room must be darkened, and light must not be permitted to escape from your lamp, except through the condensers.—A. Dean, 57, Southborough-road, South Hackney.



A, 1st condenser; B, 2nd condenser; V, ventilator; C, chimney; D, door open; S, slide; O, objective; M, mirror.

[52181.]—**Balance (?) Gear of Omnicycle.**—The vague reply of "E. G. M." to this query tells nothing, and is, moreover, misleading. In the Omni there is no sort of "balance" gear in any way analogous to Starley's invention or its numerous copies. The Omni belongs to the class of tricycles nowadays called "clutch drivers," which includes the Devon, Cheylesmore, and many others. It drives both wheels when travelling straight only, for when rounding a curve the outer wheel ceases to be driven. The *spécialité* of the Omni is its highly ingenious "segmental gear," which was one of the first, and still is, perhaps, the best, means for varying speed and power.—W. H. S.-W.

[52261.]—**Screening Gravel.**—If Mr. Booker would take the trouble to look at some of the stone-breaking machines, he would get an idea how to construct his gravel-sorting machine. I don't wish to make any unkind remarks; but it seems to me that such a query as this is purely for the personal benefit of an individual, and is of little interest to anyone else. If Mr. Booker, with all the information he can easily find in his back numbers, cannot make a machine of the kind he wants, he should seek professional assistance, and pay for it. As his query stands, an answer to it would involve several drawings and several columns of letterpress; but briefly he may be told to make an iron cylinder with holes of the size he requires, and erect it over a tank. The water must be let into the top end of the cylinder by a pipe, the other end extending over the side of the tank, and depositing the gravel in one or more heaps, if Mr. Booker requires it in two or more sizes.—Ilford.

[52263.]—**Engine.**—"Luir" should look through his back Nos. for the sketch he wants. The size of the ports depends on the work the engine is to do, to some extent; but as a guide he may make them $\frac{3}{16}$in. wide, by $\frac{3}{4}$ to an inch long; the exhaust should be $\frac{3}{8}$in. wide by three-quarter inch long: the bars about $\frac{3}{16}$in. wide. What size passages are there in the cylinder? for it is clear that it is no use leaving the ports with twice the area of the passages; they should be larger—that is all. I think the querist will find several drawings in back volumes that will be of use.—Model Maker.

[52264.]—**Fan Blower.**—The blast from such a fan ought to be quite sufficient, and a 1in. nozzle is large enough. With the fan itself and the forge surely you can easily ascertain the best speed and the best dimensions yourself—that is, if you like to take a little trouble, which apparently you do not. —S. M.

[52265.]—**Steel Burnishing.**—The only burnishers required will be pieces of steel with rounded edges, long enough to be grasped each side, so that they can be rubbed over the surface while applying as much pressure as possible. No solution at all is used. Why don't you read up the subject, if you know nothing about it? There are several articles on burnishing in back volumes. The whole art consists in getting a high polish by means of a forcible compression of the particles on the surface. No specially-shaped tools can be required for flat surfaces 5ft. by 5in.; all that is needed is a bit of good hard steel with a suitable face, elbow grease, and the will to apply it.—S. M.

[52270.]—**Simplex Telephone.**—"H. B." cannot use a telephone for business purposes without being liable for royalty. The connections seem clearly indicated in the illustration referred to; but there is no line from E to L, as supposed by querist.—E. M. P.

[52274.]—**Packing.**—The quantity of packing consumed by a locomotive depends on so many things that it cannot be stated definitely. A loco. stuffing-box properly packed will last for months, whereas one carelessly done will not last a day.—Driver.

[52277.]—**Oboe.**—If "One in Trouble" really pays 2s. each for his reeds, no wonder he is in trouble. The prepared reeds cost about 2d. each. Let your correspondent refer to pp. 20, 41, 92, Vol. XXIX. The querist should also look up his recent numbers, as, if I recollect, there was a good deal about the oboe lately.—Squeaker.

[52285.]—**Focal Adjustment of Astronomical Transits.**—You will be able to use a meridian mark 30 or 40 yards off by contracting the aperture to about one-fifth of an inch. My transit instrument has a hinged shutter for that purpose.—R. P. G.

[52287.]—**Organ Query.**—"Organ Grinder" should look up his volumes. A pipe organ, the height of which does not exceed 4ft. 6in., is really verging on the absurd; it is in every way better to have a reed instrument when so cramped. The longer pipes must be off the chest proper, and the bellows be small and inadequate. The whole thing is out of place, for the one thing needful about a pipe organ is size.—Organon.

[52290.]—**Powdered Cellulose.**—The only way of obtaining this is to grind it between millstones. —S. M.

[52291.]—**Polishing Aluminium.**—Polish in the usual way with buff-wheel, using crocus and dry lime to finish. Nickel can be brought to the highest degree of polish from the reflective point of view.—S. M.

[52307.]—**Gas-Engine.**—This query should be addressed to the makers. Perhaps they know how to do what "Volt" wants.—S. M.

[52315.]—**Ejector.**—There is no method of determining the quantity without making experiments.—X. M. M.

[52325.]—**Paper-Making.**—The microscope is the only test. Lime, plaster, china clay, &c., are the chief adulterations.—Sittingbourne.

[52338.]—**Holtz Machine.**—In your issue of the 7th inst., "A Subscriber" recommends the use of glass in preference to vulcanite for these machines. As I had made very full inquiry upon the point, I thought his recommendation very true, and am therefore surprised now to see, in a recent issue, that a contributor under the signature Paul Ward, gives opposite advice. Which of the two contributors can be right? Fortunately, we can get at the facts. Your readers will be better able to judge with these before them. They are as under —viz.: Good glass may be bought at 2d. per super. foot (it has just now risen in price); 30in. discs can be bought cut to circle at 1s. 3d. each; the drilling of the hole is done with emery and water, it takes about five minutes to bore; the total cost of a 30in. glass disc therefore is, say, 1s. 6d. I attach to this, for your own inspection only, the printed price-list of the largest makers of vulcanite, by which you, Sir, can verify the fact that 30in. discs of that material cost 50s. each, to which add the trouble and cost of "scrubbing the surfaces and dexterously coating with paraffin," making them, after all, paraffin discs. "A Subscriber" stated there was difficulty in keeping the surface of vulcanite in order. Does not the necessity of a paraffin surface go to prove this? On the other hand, I have a great many of the cheap glass discs in use; they give, I think, better results, and none of them have given trouble. As to the ozone, I dare say the machines I have had to do with were equal to vulcanite; but my nose is now so accustomed to ozone that I really don't notice it, much less do I walk in the country "to deodorise my clothes." I think I have plenty of data to enable me to put the other points mentioned by "P. W." in a different light; but I leave this to abler pens; my present object is to save any of "ours" leaping ere they look.—Another Subscriber.

[52379.]—**Banjo.**—If "A Lunitick" has not yet done anything to his banjo, I should strongly advise him, from five or six years' experience as an amateur banjoist, not to meddle with its construction in the way recommended on p. 312 by Mr. Davies and "Fiddler," as I think he would probably do a great deal more harm than good thereby. Neither should he on any account oil his vellum, unless he doesn't mind the risk of spoiling it. It might not spoil it—I cannot say whether it would or not; but I should be very much afraid myself of trying it on any but a very bad and worthless skin. A good skin should be almost as transparent as glass all over. If "A Lunitick's" banjo has a large portion of the vellum thick, white, and comparatively opaque, I think he will do well to get a new skin, and take care to choose a thin and clear one. I shall be happy to tell him how to put it on if he finds any difficulty about it. Most probably a great deal of the "tubbiness" he complains of is due to his fingers being soft at the tips and unskilful. It requires a good deal of practice to be able to bring out the full tone of a banjo. Time and practice will cure both these defects, and the tone of the instrument will improve by being played on, just as fiddles improve with use. By all means let him put marks across the fingerboard to mark the notes. They are an immense help; but they should be flush with the fingerboard, and on no account raised, as in a guitar, for the places where the strings require to be stopped in order to be in perfect tune have a curious habit of sometimes altering their position nearly $\frac{1}{2}$in. towards the hoop when a new string is put on to replace a broken one. So that, so far from the raised "frets" making it impossible to stop out of tune," they may sometimes "make it impossible" to stop *in* tune. This is a curious fact which I have often noticed, and for which I have never been able to account. I should be glad if someone could throw some light upon it. As a last hint, let "A Lunitick" make a higher bridge out of a piece of an old cigar-box, which is a first-rate material for the purpose, and let it be full $\frac{1}{2}$in. high in the middle, and I shall be much surprised if he does not find a considerable improvement in the tone.—Patent Plate.

[52390.]—**Dynamo.**—Your proportions of wire are right. The amount of iron in the armature should depend on the strength of the magnetic field—that is, it should have sufficient capacity to condense the lines of force within itself, and so prevent any of them from passing directly from pole to pole. If the inside turns of the coils cut any of the direct lines of force, currents are generated in the opposite direction to the proper or which fits tightly on to a cog-wheel, and I is the spindle which carries the minute hand (not drawn). Hope above will explain diagrams; if not, further explanations will be given with pleasure. Of, course, the bell does not ring above four or five seconds as a rule, simply because I feel it my duty to get up and stop it by unswitching a button attached to the wires.—Kiko.

Fig. 1.

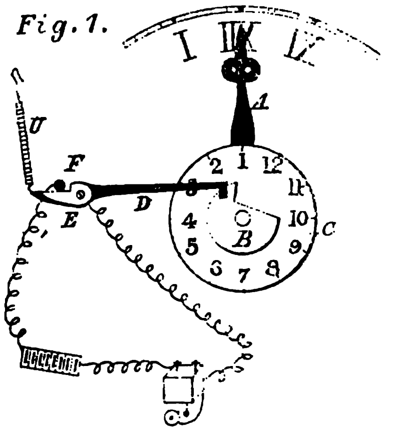
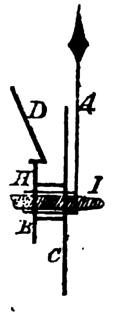
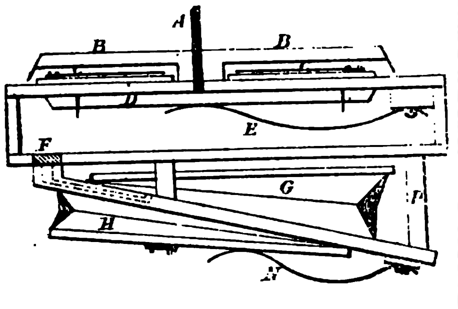


Fig. 2.



[52480.]—**Barrel Organ.**—I inclose sketch of a plan which may be successfully adopted for a barrel organ with two sets of reeds. A is the plunger; B B, the tubes; C C, the suction reeds; D, the large pallet; E, the pallet-spring; F, aperture through which the wind is drawn downwards by the reservoir G; H is the feeder, shown partly open; N is a spring used to close the feeder. Two feeders may be employed with greater advantage if preferred, though perhaps in this case one feeder may be sufficient. P P are uprights, to support bellows in position, which is on the horizontal plan. A row of short levers should be made to actuate the plungers as the barrel revolves. The feeder or feeders may be actuated by a small crank and lever. I can answer for the success of this arrangement, as it has been actually tried.—G. Fryer.



[52510.]—**Engine Speeds.**—Your first machine pulley makes 175 revs., and that on the second machine 113¾. But as you wish to reduce the first to 140 revs. I should advise you to put on it a 5ft. pulley and not meddle with the engine pulley at all. Whether you do this or your own way, the pulley on second machine must be 2ft. 8in. in diameter.—Engineer, Dewsbury.

[52510.]—**Engine Speeds.**—$140 \times \frac{5}{4} = 175$ = revs. of 1st machine. $140 \times \frac{4}{4} = 140$ = new rev. of 1st machine with 4ft. driving wheel. $175 \times \frac{2\frac{1}{6}}{3\frac{1}{3}} = 113\frac{3}{4}$ = revs. of 2nd machine. $\frac{140 \times 2\frac{1}{6}}{113\frac{3}{4}}$ = 2ft. 8in. = size of driven pulley to replace the 3ft. 4in. on 2nd machine to have the same number of revolutions as before.—T. B.

[52510.]—**Engine Speed.**—If "W. C. F." will multiply the diameter of his driving pulleys together, and the speed of his engine, and then multiply the diameter of his driven pulleys together, and divide the driver, by the driven to find the speed of his last shaft; and then multiply this speed by the diameter of pulley on this shaft, and divide by revolutions on first shaft to get the diameter of pulley required, I think he will see there is not much engineering nor mechanical skill required, or thus—26 × 60 × 140 = 218,400, and 48 × 40 = 1,920, 218,400 ÷ 1,920 = 113·75 revolutions. Then 113·75 × 40 ÷ 140 = 32·5 inches diameter of pulley required.—Firer, Dewsbury.

[52511.]—**Engine Power.**—To "Anxious One."—The way that I obtained the numbers 52,45·2, and 56·7, was by dividing the length of the stroke in inches, by the number of inches the piston had travelled when the steam was cut off, to obtain the number of expansions, and then multiply the terminal pressure by the hyberbolic log. plus 1 of the number of expansions at different points of cut-off. I think if querists would look up back numbers they would find plenty of information on "Engine Power," as the subject is nearly expended. For the benefit of our readers I will here give a few numbers of expansions, and also the hyperbolic logarithms:—

No.		Hyp. Log.		No.		Hyp. Log.
1·05	....	·049				
1·1	....	·995	....	5·5	....	1·705
1·15	....	·140	....	5·75	....	1·740
1·2	....	·182	....	6	....	1·792
1·25	....	·223	....	6·25	....	1·833
1·3	....	·262	....	6·5	....	1·872
1·35	....	·300	....	6·75	....	1·910
1·4	....	·336	....	7	....	1·946
1·5	....	·405	....	7·25	....	1·981
1·55	....	·438	....	7·5	....	2·015
1·6	....	·470	....	7·75	....	2·048
1·7	....	·531	....	8	....	2·079
1·75	....	·560	....	8·25	....	2·110
1·8	....	·588	....	8·5	....	2·140
1·9	....	·642	....	8·75	....	2·169
1·95	....	·668	....	9	....	2·197
2	....	·693	....	9.25	....	2·225
2·25	....	·811	....	9·5	....	2·251
2·5	....	·916	....	9·75	....	2·277
2·75	....	1·012	....	10	....	2·303
3	....	1·099	....	—	....	—
3·25	....	1·179	....	—	....	—
3·5	....	1·253	....	—	....	—
3·75	....	1·322	....	—	....	—
4	....	1·386	....	—	....	—
4·25	....	1·447	....	—	....	—
4·5	....	1·504	....	—	....	—
4·75	....	1·558	....	—	....	—
5	....	1·609	....	—	....	—
5·25	....	1·658	....	—	....	—

—Firer, Dewsbury.

[52514.]—**Siemens Dynamo.**—If you have these diagrams and cannot understand them, I am afraid I cannot help you. The diagram I should have sent was one of these. The difficulty of winding these A.'s is that to make the coils all alike you must wind one layer of each coil at a time, so that you have 16 coils to wind all at one time, which is rather trying, as the wire is so apt to slip off.—W. H. E., Coventry.

[52518.]—**Waterwheel.**—500 gallons of water weighing 5,000lb. per second = 300,000lb. per minute; falling 5ft. = 1,500,000 foot-pounds per minute; divided by 33,000 = nearly 45½ h.p. A wheel for this fall would be an "undershot," or perhaps a "half breast," developing, at most, 35 per cent. of power = 16 h.p. The "creation" of the complement up to 70 h.p. would be a peculiarly interesting mechanical problem.—R. J. L.

[52518.]—**Waterwheel.**—"Tinker" cannot obtain 70 horse-power from the fall he describes. A waterwheel is only an appliance for utilising the power inherent in the fall. With the Editor's permission I will show in plain figures what this power amounts to. As 33,000 falling 1ft. per minute is a standard horse-power, we must find how many pounds of water is going over the fall per minute, and multiplying this by the height, which will give us the foot-pounds, dividing this by 33,000, shows the horse-power, thus:—

500 = No. gal. per sec.
60
30,000 = No. gal. per minute.
10 = Wt. of 1 gallon.
300,000 = Wt. of water falling per minute.
5 = Height of fall.
1,500,000 = Total ft. pounds.

Divide this total by 33,000 and we have 45½, nearly, as the theoretical horse-power of the fall in question. Practically, however, not more than about 65 per cent. of this power can be utilised by any machine at present invented; therefore, we must submit the result obtained to another short arithmetical process as follows:—45½ multiplied by our percentage of 65 and divided by 100 gives us (leaving out the smaller fraction), 29½ as the effective horse-power obtainable from the fall. "Tinker" does not state the purpose he wishes to apply the power to when obtained; as this will govern the kind of wheel to be erected, so as to obtain the best practical results. I shall be pleased to pursue the matter further if he gives this information, some kinds being adapted for a slow pumping motion, and others for quick speeds. Noticing that questions of general interest like "Tinker's" are often answered by formulæ, which is usually an algebraic statement of figures and signs only intelligible to those who have been fortunate enough to receive a higher education than most of us of the old school can boast of, and having at various times been disappointed at finding answers to such questions are given in "ours," after this manner, I have answered the above in the plainest possible way, trusting other writers will also take the hint, and not forget "ours" is the Mechanic, and not a paper circulated entirely amongst members of some scientific society who have mostly received a university education. It has not escaped me that a little extra space is required for detailed answers; but we must hope that our Editor is willing to dispose of a portion of his stock of the milk of human kindness for the benefit of his readers.—Moorman.

[52529.]—**Aluminium.**—Thanks to "K. G.," "Sigma," and "S. R." The quotation from *Industrie Blätter* is both useful and interesting; the greatest difficulty I have found, especially with copper, is the oxidation of the metal itself, a thin cake of the copper peeling off with the aluminium; with gold this is not so. It is with copper I am most anxious to succeed: any suggestion to obviate this difficulty will greatly oblige. I employ a low heat.—Zelia Naien.

[52536.]—**Bricks in Wall.**—If the wall is to be of solid brickwork, the number of cubic inches in the wall divided by the number of cubic inches in a brick will give the required answer. Thus,

$$\frac{50\text{ft.} \times 25\text{ft.} \times 9\text{in.}}{9\text{in.} \times 4\frac{1}{2}\text{in.} \times 3\text{in.}} = 13{\cdot}333 \text{ bricks.}$$

—J. M.

[52536.]—**Bricks in Wall.**—Cubical content of wall = 50ft. × 25ft. × 9in. Bringing each of the quantities to inches, we have—

$$50 \times 12 \times 25 \times 12 \times 9.$$

Cubical content of brick = 9 × 3 × 4½. Dividing cubical content of wall by cubical content of brick—

$$\frac{50 \times \overset{4}{12^*} \times 25 \times \overset{4}{12^*} \times 9^* \times 2}{\underset{3}{9^*} \times 3^* \times 9^*}$$

By cancelling, we get $\frac{40,000}{3} = 13,333\frac{1}{3}$. Therefore, 13,333⅓ bricks will be required to build the wall.—J. Byatt.

[52540.]—**Incrustations in Boilers.**—If "Ferro" will communicate with me privately, I can arrange for him to see a softening apparatus in work. I have four boilers and a large water supply (about 10,000 gallons per diem) under my charge, and since using the softened water have had no incrustation. The operations of softening, filtering, and pumping are performed simultaneously. This is not the Porter-Clark process; but judging by my own experience, this system may perhaps be as suitable to "Ferro."—Aqua, 39, Kynaston-road, Stoke Newington, N.

[52541.]—**A Curious Photographic Experience.**—I am surprised at your not obtaining a trace of a photograph with an exposure of ten minutes in limelight, for I once tried to photograph a picture of statuary thrown on a screen with a three-wick oil lantern, and I exposed two plates, one for five minutes and the other for ten minutes. On developing, the first plate was without a trace of an outline; but the second showed up the picture, but not strong enough to print from. My plates were "Derby" extra rapid, and I developed with hydrokinone and ammonia. So you ought to have got a picture with limelight.—J. S. Gladstone.

[52548.]—**Wharf Crane.**—"Vaga" should say what power he intends using. If hand-power, I can give measurement of a very satisfactory and light-working crane not to exceed 10 tons. Six men at handles; chain barrel, 9in. diam.; large wheel, 4ft. 6in. diam.: 2nd wheel, 2ft. 9in. dia., and pinion 7in., the last pinion 7in. also. It is good to remember that no one can tell how much too strong a crane is; but it is easy, if a crane falls carrying destruction with it, to understand that it is too weak. A crane calculated to lift 10 tons by engineer's rule, should be used only to 5 tons.—Wm. Hosken.

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* Erased figures.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

52069.	Metropolitan Building Act, p. 183.
52073.	Penang, 183.
52082.	Contents of Box, 183.
52086.	Learning the Zither, 183.
52093.	Load on Columns or Stanchions, 183.
52099.	Agricultural, 183.
52101.	Induction Coils, 183.
52106.	Jacquard Loom, 184.
52110.	Mangle Rollers, 184.
52115.	Bramah's Press, 184.

52258.	Soap Cutting and Stamping, p. 272.
52262.	Leclanché Battery, 272.
52282.	Screw Press, 273.
52288.	High Pressure Valves, 273.
52295.	Iron Boxes, 273.
52297.	Imitation Sealskin, 273.
52314	Oxy. and Dioxy. Benzenes, &c., 273.
52316.	Telescope, 273.
52318.	Cooking Apparatus, 273.
52326.	Watch Jobbing, 273.

QUERIES.

[52578.]—**Aniline Ink.**—I should like to know if there is any permanent aniline colour of the same tint as a weak solution of iodide of potassium, and in what form it could be obtained?—C. T. THRING.

[52579.]—**S.E. Engines.**—Are there any single engines on this line besides Cudworth's 7ft.? and if so, a few particulars of them would oblige.—W. B. P.

[52580.]—**L.B & S.C. Engines.**—Would any one give a short account of Craven's engines on this line, their dimensions, where built, &c., especially of the 6ft. double-framed singles and the old goods? Were outside cylinders ever used on the L.B. & S.C.R.?—W. B. P.

[52581.]—**Thimbles.**—Could any one give me information respecting the manufacture of thimbles, how they are pressed or moulded into shape?—W. J. B.

[52582.]—**Copperplate Printing.**—Could any of your readers give me full details for making copperplate printing press to print etchings, largest size 9in.? A sketch, with dimensions of rollers necessary, would be esteemed.—COPPER.

[52583.]—**On Demand.**—How long is a bill "on demand" of value as a security, and can it be written "to bear interest"?—G. HARLEY.

[52584.]—**Magic Lantern Lamps.**—My three-wick refulgent lamp, burning paraffin, gives off an offensive smell when in use. It is kept as free as possible from any oil on the outside. Is there any remedy? What is the best way to trim the wicks so as to avoid as much as possible a pointed flame?—ROBERT JAMES.

[52585.]—**L. & S.W.R. Engines.**—To "CLYDE." Can you kindly give me numbers of 190 class (well tanks), 46 class (bogie tanks), 10-wheel tanks, new bogie passenger, and say how many of 380 class are there?—CARSTAIRS.

[52586.]—**L.N.W.R. Engines.**—Can any one kindly say what are the dimensions of engines 1182—1187, which were known as the low-domed Bury's?—CARSTAIRS.

[52587.]—**Incandescent.**—Will Mr. W. E. Dawson kindly give size of cells and zincs, carbon, &c.? Also the proper quantities of bichromate of potash and sulphuric acid to charge each cell, mentioned by him in answer to Bunsen Battery (query 52248)?—THERMO.

[52588.]—**Fireclay Furnace.**—I wish to make a small furnace for melting iron and brass? It must be large enough to take a No. 10 Morgan's plumbago pot. I have a 12in. fan to supply the blast to two tuyeres opposite one another. I think of building it of firebricks and clay inside a sheet iron case. Will some reader kindly give best shape and dimensions? Also inform me to what extent the size of the fuel and power of the blast modify the capacity of the furnace?—J. M. BESEAL.

[52589.]—**Battery.**—I am making a battery to light a small lamp for household purposes, and I wish to know how many cells I shall want, and how long they will last without recharging when made in the following manner? I have an outer earthenware jar containing a saturated solution of sulphate of copper, in which I immerse the copper plate and a porous jar containg sulphate of zinc, and the zinc plate immersed therein. Any hints will be thankfully received by—ROBERT S. HARGREAVES.

[52590.]—**Boring Head.**—Will some correspondent give description and drawing of a boring head to bore 3in. cylinder on 5in. slide lathe? Slow speed, four revs. of flywheel to one of mandrel. Please show number, size, and shape of cutters. What is loam—as used for casting?—SAILOR.

[52591.]—**Elliptograph.**—Can any correspondent describe the elliptograph exhibited at the Amateur Mechanical Society's conversazione on the 5th inst. by Mr. Inwards?—P.

[52592.]—**Theory of the Sun's Motion.**—To what does the President of the Royal Astronomical Society refer, when, as at the last meeting of the Society, he says, "When a change is made in the theory of the sun's motion, it will necessitate a corresponding change in the length of the mean day"?—P.

[52593.]—**Clayey Soil.**—My new garden is most of it of a very clayey soil. How will such soil suit for potatoes, cabbages, and fruit trees? If unsuitable, would some reader kindly suggest a plan to improve the ground?—SKEELIM DARG.

[52594.]—**Power for Lathe.**—Will some of our engineering friends kindly inform me what would be the stroke and diameter of cylinder of an engine required to drive a 3¼in. centre lathe, and about what would be the length and diameter of Cornish boiler to supply the same with steam not exceeding 50lb. per sq. in.—LEG-WEARY.

[52595.]—**Rapid Lens Shutter.**—Can some reader kindly give me an idea for making a rapid exposure shutter to be worked by springs on the inside of the lens tube, and to open and close in the centre, and if possible to be made so that any length exposure may be given? I should like to know whether such a shutter can be worked without cutting the lens tube.—C. R. H.

[52596.]—**Engine for Boat.**—I have a boat 26ft. long by 6ft. wide. I should like if any kind reader would tell me what size of an engine and boiler would be large enough to work it, as I intend to make it into a launch? Also what size propeller?—NEPTUNE.

[52597.]—**Soldering Joints of Gutter Buckets.**—Would any reader who has had practical experience in mounting gutter buckets for pumping inform me as to the best way of soldering the joint to make it as strong as the rest of the bucket? Also, what kind of gutter is best for the purpose of pumping?—BUCKET.

[52598.]—**Stenciling Ferns and Grasses on Wood.**—I want to lay fern leaves, &c., on white wood, and afterwards splash them with a brown liquid or powder—the wood being previously sized to receive the powder; but I do not know the *modus operandi* or the materials used, and I should thank my fellow-reader who understands this work to give me full directions, as after it is done I wish to varnish the work, taking away the fern leaves, &c., for such work as drawers or escritoires, &c.—LEO.

[52599.]—**Freezing Mixture.**—Can any of your scientific readers give me a formula and quantities for a freezing mixture, such as Prof. Tyndall used for bursting shells in a lecture room? Also, are the general public admitted to the Royal Institution lectures, or are they restricted to a certain class? Any information on this point would greatly oblige.—A. H.

[52600.]—**Proving Will.**—Having been appointed executor of a will in which I and my brother take shares of the property from our mother, I should be glad to know whether I can, without much trouble, prove the will, and go through the necessary business without the aid of a lawyer. Would the people at Somerset House give me any help?—J. C. WYNDYARD.

[52601.]—**St. Petersburg Standard.**—Will some correspondent kindly explain how boards and deals are converted into this measurement, and extend Std. 2 . 1 . 29$\frac{7}{18}$ at £8?—JN. WILSON, Jr.

[52602.]—**To Chemists.**—In an experiment with soda and lime a pink salt has formed. I should be glad to learn if there is any known compound of these salts of this colour, or if I should look for impurities as the cause?—ZELIA NAIEN.

[52603.]—**Asbestos.**—Can any of ours tell me of any use to which artificially-produced powdered asbestos could be put? I obtain it as a by-product.—ZELIA NAIEN.

[52604.]—**Variations of Draught.**—Can any of your readers tell me how I can make something to show the "pull" or draught of the fire of a Lancashire boiler? I want to ascertain the variations of the draught under different conditions.—KENWAY.

[52605.]—**Earth Contact.**—I have two earth contacts to make. Can any of your correspondents tell me if sheet zinc will do for the plates, as I have some old sheet by me? If so, what would be the best size to make them, and what must I bury them in, and how deep? I want them to ring a bell at a distance of about 200ft., and can get no water or gaspipes to put the earth wire on to.—G. I. C. E.

[52606.]—**Thermometer Box.**—Will some obliging correspondent describe a louvre-boarded box for thermometers to contain the usual wet and dry bulb, maximum and minimum? The particulars I require are—the inside measurements, the size of the timber used in the framework, and the number, distance apart, width, and thickness of the louvres. I presume it should be all made of wood. I know that, for the purpose of comparing records, such boxes should be as much alike as possible. I am sure that "F.R.A.S." uses a properly-constructed box, and hope he will be kind enough to describe it.—AGRICULTOR.

[52607.]—**Soap.**—Would "London Stone," or other soap boiler using steam solely, suggest a remedy for the too rapid weakening down of the leys by reason of the boiler injecting into the pans a quantity of water with the steam, thereby rendering it difficult to open or grain the soap. Would steam in inclosed coils do? I know dry coils are used, but having tried them for melting tallow and failed, I have not much faith in their being effectual. Another trouble: My boiler, pans, and pipes are exposed. What is the best way to protect them from the cold? Some tell me cement is a fraud, others recommend it strongly. Information from any one having experience would oblige.—PHILO.

[52608.]—**To Mr. P. Ward.**—I am at present experimenting on the electrical discharge *in vacuo*, but find some difficulty from the unsteadiness of the strata, and I propose to order from Apps one of the rapid breaks as used by the late Mr. Spottiswoode. I shall be glad to know if that will render the strata steady, and which pattern is the best for the purpose?—H. A.

[52609.]—**Working a Pump.**—I rejoice in immunity from water-rates, but am proportionately punished by having to exercise my corporation daily, Sir, in drawing or forcing by pump-action a double cistern supply, as if I were a galley-slave, or on board a burning ship about to go to the bottom of the ocean. The water is from an Artesian well, and I wonder whether any of your myrmidons of science would hold out hope that the muscular labour could be abridged by aid of some simple form of engine, gas, steam, or electrical, and if so, in what way, and at about what outlay?—DIDASKALOS.

[52610.]—**Paper Scenes.**—Being interested in the getting up of dramatic entertainments for the purpose of raising funds for Sunday-school prizes, &c., I should like to know if I can get any paper that would answer in place of the scenery which has to be hired for the purpose, as it takes all the shine out of the proceeds when about £2 has to be paid for one night's hire. If I can get anything that will do, I have a plan for making the scenes so as to be able to change them when required.—EDWARD MACKENLEY.

[52611.]—**Binocular Eyepieces.**—Will any one who has used Nachet's, Tolles', or Zeiss' binocular eyepiece (or that of any other maker) give the result of his experience? What is the magnifying power of the eyepiece? What is the highest power of the objective with which it can be used? Is the definition impaired to any appreciable extent? Is the field contracted? And lastly, Can any one of these eyepieces be used with advantage with any form of telescope?—E. D. W.

[52612.]—**Analysis of Lime.**—Can any of our chemical readers inform me how to make the analysis of Buxton lime used in causticising soda ash? What are the advantages gained by blowing air through the soda solution before adding the lime? The pan I use is fitted with agitators and steam pipe, and my object is to produce a fairly pure solution of caustic soda testing 18° to 26° Twaddell. I should like to know what saving is produced by blowing air through the liquid.—F. H.

[52613.]—**Mandoline.**—I have never heard this instrument played. As compared with the guitar (which I know well), what are its qualities (1) as an accompaniment to singing, (2) as a solo instrument, (3) facility in execution, (4) timbre—i.e., quality of musical sound, (5) does it require music to be specially arranged for it, or can average accompaniments be performed on it without adaptation?—W. H. S. W.

[52614.]—**Chromoscope.**—I wish to obtain an instrument called Stammer's chromoscope, designed for determining variations of colour-depth in beer. The following references from the French work are given in *Polytechnic Journal*, Vol. CCXVI. page 57, and Vol. CCXIX. p. 147. Any information as to these references would be useful, as I cannot find them. The following is a translation of a description of the instrument, translated from "La Bière" par Cartuyvels et Stammer:—"Messrs. Kohlrausch and Schwackhöffer have, in their remarkable works on Austrian beers, made use of the Stammer chromoscope to establish the relations between the composition of beers and their colour. The instrument comprises a reservoir for beer (I.), a tube or measurer (III.) bound to a colour-tube (tuyau à couleur—II.), and movable with it. The coloured glass adapted to (III.) is composed of two identical twin discs. An ocular allows of a simultaneous observation of the coloured discs. The instrument is mounted on a pedestal, having below a white unwrought mat mirror. The chromoscope is regulated so that in looking in by the eyepiece, after removing the coloured glass, one sees a circle uniformly lighted up, exactly divided in two. The coloured glass is replaced, and the beer, filtered and perfectly bright, is poured into the reservoir (I). The movable system is next displaced vertically until uniformity of tint is re-established. The appended table allows of direct expression of the colour of the beer in absolute numbers, comparable for every case and every instrument of like make. After each observation the instrument ought to be thoroughly rinsed with distilled water. A complete cleansing is always indispensable. This washing is much simplified by the special arrangement of all the parts of the instrument." Extracts from the table:—

mm.	Colour.	mm.	Colour.	mm.	Colour.
1·	100·	40·	2·5	2·0·	·50
9·	11·1	50·	2·0		

If any ingenious reader could offer a rough drawing answering to this description, and accompanying explanation, I should be much obliged.—C. T. THRING.

[52615.]—**Copper Reduction.**—I was much interested in reading Mr. William E. Dawson's description of the methods of copper reduction in a recent number, and I hope he will fulfil his promise by giving in your next number the description of the "best metallurgical process" he speaks of. I know of several copper mines, poor in ore, which cannot be worked in the ordinary way, but which probably could be worked to a profit by some cheap wet process. I should like to ask him if the processes he has already described are commercially payable, or if any wet process—such as dissolving the ore in sulphuric acid, and then reducing by scrap iron, &c.—can be made to pay, and if so, what would be the cost of plant, and of reduction per ton?—CHAS. E. BARNARD.

[52616.]—**Gas-Engines.**—Will any correspondent tell me what is the use of the rubber bags that are fixed on the gaspipes supplying engines? Some have one and other kinds two. Do they play any important part in the real working of the gas-engine, or if the engine would just work as well without them?—J. NICHOLS.

[52617.]—**Clarionet Playing.**—(1) I have a B flat clarionet with 13 keys. What is the use of the twelfth key from the bottom? I have not seen it mentioned in the fingering tables of instruction books. (2) Can I do away with transposing by means of the following method? Always playing music as written for the piano, and learning from the beginning to call the note on the clarionet by the same name as a note which is in tune with it on the piano.—W. B. LEIGH.

[52618.]—**Seismometer.**—Will some one please give a description, with diagram, if possible, of a seismometer? I don't mean of a home-made makeshift one, but of a recognised form of instrument, and oblige.—J. BYATT.

[52619.]—**Imitating Bronze.**—I have some small wooden objects which I wish to paint to resemble bronze. Could I make a paint with fine metallic copper, or some other metal, and burnish it?—E. W.

[illegible]—**Pyrotechny.**—What books, French or English, are there on this besides "Browne," "[illegible]" [illegible] "Cassell's Recreator"? Has [illegible] been [illegible]? What is a Mount Vesuvius? [illegible] smoke from balloon contrived? —[illegible]

[illegible]—**Siemens Dynamo.**—I have castings of [illegible] field magnets 8in. [illegible] Kindly give me size of wires and the [illegible]—Constructor.

[illegible]—**Oxy-hydrogen Lantern.**—I have been much interested in recent correspondence on this subject, and I hope that it may be continued. Will some one kindly tell me if I can get a bright disc with [illegible] at a distance of [illegible] from the screen by [illegible]. In other words, would there be much waste of light in working at that distance? I also wish to know if it is possible to show [illegible] satisfactorily to a large audience with the [illegible] I have tried was useless. I am [illegible] beautiful enlargements; but I want to be able to show [illegible] as well.—W. H. [illegible]

[illegible]—**Mural Decoration.**—I am about to paint the walls of my drawing-room with [illegible]—panels of [illegible] with a [illegible] conventional designs [illegible]. Will some correspondent kindly tell me what should be done to the walls as a preparation for painting? [illegible] the old paper will be washed off. Should the walls then be papered with a thin white paper or a [illegible] paper, or should they [illegible] with any preparation of distemper or enamel, and if the latter, what is it called? Any hints will greatly oblige.—[illegible]

[illegible]—**Dyeing Bunting.**—I wish to know how [illegible] bunting [illegible]. The [illegible] blue, red, and white [illegible] the different [illegible]—[illegible]

[illegible]—**Field-Glass.**—[illegible] field-glass, how am I to determine the magnifying power of same? [illegible] About what power and what angle of field of view should a first-class field-glass [illegible]? What are considered the best proportions for [illegible]?—[illegible]

[illegible]—**Wimshurst's Influence Machine.**—To Mr. [illegible]—Would [illegible] kindly tell me where I am wrong? I have just made a Wimshurst's I. M. from description given in "E.M.," Vol. XXXVI. No. [illegible]. My glass plates are 16in. diam., well varnished; the brass sectors are [illegible] wide at the top, [illegible] and they are [illegible] and are cemented on [illegible] from edge. Two of the sectors on each plate [illegible]. I have [illegible] brass tubes [illegible] which are made of fine brass wire and [illegible]. [illegible] the ends of [illegible] brass tubes carrying brushes are fixed by a [illegible]. The plates are [illegible] hard wood bosses by cement, and [illegible] through the plates, the [illegible]. The plates are [illegible] apart [illegible]. The fixed conductors are [illegible] supported on glass pillars. The stand is made of very dry wood. But when I warm the machine and rotate the plates rapidly, I cannot see any [illegible]—[illegible]

[illegible]—**[illegible] Colours.**—Why [illegible] the presence of [illegible] the production of [illegible] and why [illegible] these [illegible] the ex[illegible]—[illegible]

[illegible]—**[illegible] by Machinery.**—[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

and is there any economic advantage in such an arrangement?—W. F. Harcourt.

[52634.]—**Fluorescence.**—Any hints as to the illustration of this curious effect will greatly oblige, especially with stramonium, which is often quoted as very effective and which I have tried in a variety of ways, but with no result. I find the magnesium light superior to both the electric and the lime light for quinine and such experiments.—W. F. Harcourt.

[52635.]—**Singular Convulsions in a Young Child.**—Can any of your numerous readers assist me in discovering what is the matter with my little boy, aged two years and a half? About three months ago I observed that he would suddenly change colour, close his eyes, and go off into a kind of stupor for a few seconds, and afterwards breaking out into a profuse perspiration, leaving him with a deathly pallor over his forehead, and very purple round the eyes, always falling into a sound sleep immediately afterwards. I took him to the Children's Hospital, but they could not tell me what to ascribe these symptoms to. I have also consulted two private doctors; but with no satisfactory result. What I am anxious to find out is, could cutting his back teeth give rise to what I have described, or is it anything more serious? I should add, he sometimes has five or six attacks in a day, and occasionally goes a day, or even three or four days, without any at all.—Anxious Mother.

[52636.]—**Dihedral Angle.**—In my technical trade book, on the application of solid geometry to my work, the above words occur. I have asked the Grammar Schoolmaster here, and he cannot tell me. Will some kind fellow subscriber do so?—Coachmaker.

[52637.]—**Dog-cart.**—Will some fellow-subscriber inform me the true mechanical principle where to put the axle of a two-wheel dog-cart, to carry one, two, three, or four persons, without any luggage?—Coachmaker.

[52638.]—**Cement.**—What is the best kind of cement to use for putting together the mortise and tenon joints of out-door window sashes?—Chips.

[52639.]—**Netting.**—Will anyone kindly give me a few hints to enable me to make a net for lawn tennis? I learnt a few years ago, but have since forgotten it. Is there a book on the subject?—Hammock.

[52640.]—**Gumming Machine.**—Can anyone kindly send me the plain description of a machine for spreading gum or varnish over paper so as to get a smooth surface, say, demy size paper?—Gum Paper.

[52641.]—**Manganese Battery.**—Will Mr. Lancaster kindly tell me the best way to construct this battery? I must just add that I have made one or two up in the ordinary salt jar by placing a piece of thin wood as a porous portion, allowing only a third of the jar for the zinc. Now, is it best to use a small porous pot or a partition of wood? I seal the manganese part of the cell over with pitch, &c.—Onward.

[52642.]—**Copper Deposition.**—I have seen large pieces of work, ships' rams, and calico rollers, with a very thick coat of deposited copper upon them, and I believe the copper is so fast that the two metals cannot be separated, the deposited copper having so far penetrated the pores of the metal to such an extent. I also learn that locomotive and marine steel boiler tubes are done in the same way. Can any of "ours" give some idea how these articles are prepared to receive so fast a deposit, also the kind of solution used? There must be other processes than the ordinary methods for preparing these large surfaces. Smaller surfaces can be deposited upon to stand fast and the burnish applied, but the above must be very fast indeed to allow of the heat and expansion and contraction they are subject to. Any information on the subject will oblige.—An Old Subscriber.

[52643.]—**Silber Lamp.**—The flame of my Silber lamp has an unpleasant habit of jumping up spasmodically, accompanied by a slight report. The shocks at first are very slight, and about sixty to the minute. The speed gradually decreases, but the violence becomes greater till at last the lamp is extinguished. What is the cause, and is there a remedy? I have tried various chimneys.—F. Search.

[52644.]—**Rusty Turpentine Tank.**—My iron tank has got rusty, and turns the turpentine red. Will some fellow subscriber kindly tell me the cause, and its effect on the turpentine, and how to remedy it?—Coachmaker.

[52645.]—**Painting Bicycle.**—Could any of our readers of the "E.M." kindly inform me the ingredients and what proportion to use in painting a bicycle? I have tried common japan, and after the japan has dried, I have applied a coat of copal varnish, but find the japanning will not dry. Can any of our readers help me out of the difficulty?—Dublin.

[52646.]—**Continuous Brakes.**—To Mr. Stretton. Would Mr. Stretton kindly give his opinion on the following mechanical brake? 1. Of brake that could be put on or taken off by enginemen or guards. 2. It would go on in case of coupling breaking, to the detached portion only. 3. It would use the momentum of the train to create brake power. 4. It would not be affected by the weather, as it would require no steam, air, or vacuum pipes. 5. It would utilise all the brake-gear at present in use, with the exception of the cylinders and pipes. 6. It would dispense with the expensive engine brakes in use, and consequently save steam and coal. 7. It would be very simple in action. 8. If anything should go wrong with the gear on one coach, it would not interfere with the brake power on the other coaches, either before or behind. I have partly made a model coach, and am fitting it according to the above; but I should like Mr. Stretton's opinion before proceeding much further. I would have written Mr Stretton privately, but I thought he would rather it appeared in the "E.M.," as I believe he is taken as an authority on this question in your paper. Would he also say at the same time what are a few of the Board of Trade requirements in this matter, if I am not asking too much? As I am a working man, I have not many facilities of getting to know these things, except through the English Mechanic.—Near Sheffield.

[52647.]—**Drainage.**—Would any of our readers inform me if I can claim compensation for damages from the local board of health under the following circumstances? My warehouse has a drain for carrying off spring water, about 15ft. long, with a fall of about 18in. running into the main sewer, which is under the control of a local board of health. At times, this main sewer becomes blocked at a distance of 100 to 250 yards from my premises, causing my warehouse to be flooded with sewage, and putting me to a great expense.—Flooded Warehouse.

[52648.]—**Model Locomotive.**—Will someone who is a fellow subscriber of the "E.M." kindly help me in the above? I wish to make it with cylinders 1in. bore by 2in. stroke; what size and strength ought copper boiler to be to stand a pressure of 120lb., so as to keep steam up when feed-pump is working, and to use coke for fuel? Also, size of firebox and number of tubes. A small sketch of boiler will greatly oblige, and any other particulars as regards engine.—Amateur.

[52649.]—**Varicose Vein.**—Would any of our medical readers kindly advise on the above? Having been subject to the above for the last three or four years, I took very little notice of it until lately, as it has started being very painful, and a tendency to cause a kind of stiffness below the knee. I might say that the vein starts just below the hip-bone on the right leg, and extends below the knee, and finishes like a small bunch of grapes. Any information will gladly be received by a—Poor Sufferer.

[52650.]—**Drain.**—I am laying down a drain 120yds. with 12in. clay pipes. What I require to ascertain is, would the pipes be sufficiently strong enough to carry the water during that distance, with a decline of 9ft., to force upwards a distance of 7ft., to turn a water-wheel for my woollen factory?—Thomas Davies.

[52651.]—**Hot-Air Closets.**—Will someone kindly give details and dimensions for fitting up one of these for private laundry use, with, if possible, and with Editor's permission, drawings, showing plan for racks to run in and out, and description of suitable firestove? Can one be made wholly of wood, so as to be built in the corner of an existing room?—B. O. B.

[52652.]—**Regenerative Burners.**—To Mr. T. Fletcher, Warrington, or Others.—Is the principle, adopted in so-called regenerative burners, of heating the gas as well as the air previous to combustion, sound, or is all the benefit derived from heating the air which supports the flame?—W. F. Harcourt.

[52653.]—**Electrical Currents.**—Do they really differ in quality, so to speak, as well as quantity, and how can these differences be ascertained? After reading most of the ordinary textbooks, I believed that "current" was always of one kind, though differing in amount; and that, in accordance with $C = \frac{E}{R}$, an increase of power in Volts, from battery or dynamo—or a diminution of resistance in ohms in external circuit—simply gave more force of current in ampères. Mr. Sprague's book, however, if I understand it rightly, does not quite imply this; but Fleeming Jenkin says expressly that a current cannot have other qualities than "magnitude, position, and duration," and warns his readers against older theories of "intensity and quantity currents." But in magazine articles, &c., currents are now spoken of as differing in quality of tension as well as in quantity of force. In fact, one illustration is given from the way in which water flows at high pressure from a small pipe—or at low pressure from a larger pipe—the effective power being the same in each case. Supposing this characteristic to exist, what is the formula for expressing it? And can it be measured by the galvanometer and resistance box?—Antares.

USEFUL AND SCIENTIFIC NOTES.

◆

The New South Wales shale yields, on an average, about 150 gallons of crude oil per ton, which contains over 60 per cent. of refined kerosine oil, and the remaining products consist of gasoline, benzine, spongaline, paraffin, wood-preserving composition, and lubricating oil. Its gas-producing capabilities amount to the large yield of over 18,000 cubic feet of gas, with an illuminating power of thirty-eight to forty candles. On this account it has been found advantageous for mixing with ordinary coal in the manufacture of gas.

The grey dust gathered from the lower doors of boiler furnaces after shaking the fires, and sifted through an ordinary milk-strainer, makes the finest of polishing powder for tin, table knives, silverware, &c., not leaving a scratch. Yankee peddlers have been known to sell it, disguised with a fancy colour.

A recently invented Boston machine cuts two, three, or four half-round hoops from a pole, according to size, and at the rate of 20,000 to 50,000 per day. One of the results of its introduction will, it is said, be the utilisation for this purpose of the "tough and almost indestructible ironwood saplings, which resist the tools of the cooper."

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 11, 1884.

THE DEAD-CENTRE LATHE.

IN face of the excellent articles on the "Construction of a Cheap Lathe," which are, in fact, illustrative of the construction of lathes in general, as well as of that special design, I might hesitate to retrograde a step for the purpose of saying a word or two in favour of one of a different and more primitive class. But it is, in fact, a cheaper lathe still than that described—a lathe that any handy man can make without even the cost of a single casting, or the use of a lathe with which to construct it; and it is, therefore, available even for a mechanically-inclined cottager who may feel the need of such a machine to carry out his work. There are, indeed, scores—nay, hundreds—of such in our villages who, of sheer necessity, hesitate to enter the shops of the cheapest of lathe-makers. And although turners, properly so-called, may despise such a tool, it has its own advantages. That a lathe with dead centres will turn an object accurately is not only beyond question, considering that the watchmaker's turn is just such a machine; but this is theoretically the best way to insure accuracy. Moreover, it is possible that some of our readers may have followed a plan which I have myself adopted when the lathe at hand is too heavy a one for some light job. In this case the ordinary centres may both be used as dead centres, and the work driven from the overhead with a fine cord coming down to a pulley attached to the work itself, the same as is done in turning watch and clock arbors and pivots. Using a pair of fine centres, a drill-bow can be substituted for the overhead, and the ordinary lathe converted for the occasion into a set of "turns." In a periodical, long ago defunct, devoured by the insatiate ENGLISH MECHANIC, I once described a very elaborate bow or pole lathe, from Plumier's work, and I was myself surprised and interested to find how much had been done to perfect that most primitive of all lathes, and I never regretted the time I then spent in examining the elaborate details given in the bulky volume in question. Such lathes were dead-centre ones, but were vastly improved from their clumsy-looking ancestor, the chairmaker's pole lathe. This last, however, strange as it may seem, is not extinct; and is used by preference for turning certain articles, even where the modern form is found in the same workshop. The dead-centre lathe, to which I wish now to direct attention, was the result, no doubt, of the general introduction of the crank and treadle, and was, therefore, one step in advance, and a very important one, as continuous rotary motion was thereby given to the work. The lathe thus modified was constructed mainly of wood, which was of a massive character, as iron was very often turned in these lathes, of which I know a very good specimen in a smith's shop at the present time. In this case, however, there it a large flywheel, turned by an assistant, instead of the more convenient crank and treadle. The movable poppet of beech has an ordinary-pointed iron bolt, with capstan head passing through it, the point of which is steeled, and the poppet is of beech, sawn out of a plank 3½in. or 4in. thick. The under part takes a good bearing on a bed of stout oak, and is made with the usual tenon and clamping screw. The fixed headstock only needs to be sufficiently stiff and strong to carry the bolt, which serves to centre the work at that end; but this bolt must be of such size as not to bend under the influence of the driving strap, as it cannot be supported at both ends. Its point should be of steel, well hardened. Fig. 1 gives a fair notion of the upper part of such a lathe, and details of its several fittings are illustrated below. The main poppet or headstock has not two uprights, as in an ordinary lathe, but is a solid block of wood bored transversely to receive the bolt already mentioned. This bolt is made like B, with a flange at *a*, a plain cylindrical part *b*, followed by a short length of screw *c*, and beyond it the point *d*. Although better turned, it will do well enough merely filed up, the neck *b* being rounded as well as possible. Of course, this bolt should pass horizontally through the poppet; but in this lathe such slight inaccuracies as would be fatal in an ordinary one are not of paramount importance, owing to its having no revolving mandrel whatever. If the points supporting the work are not accurately true, one being possibly a trifle higher or lower than the other, yet this will not necessarily prevent true work from being turned upon them. If a running centre, on the contrary, such as that of a mandrel called the live centre, is but a hair's breadth out of truth, it will describe a circle as it revolves, carrying that end of the work with it, as most turners know to their cost; so that trueing-up the centre is a frequent operation. Here, except when worn by use, no such work is required; and if hardened the centres will last a long time.

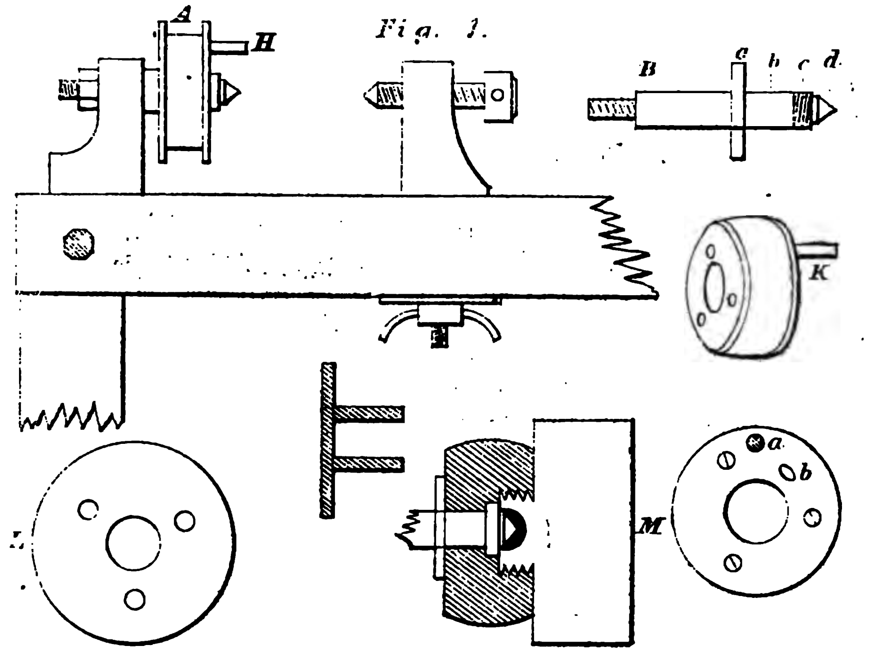


Fig. 1.

But I do not speak of inaccurate fitting not being fatal in order to commend it; and in this, as in other lathes, the better it is made the better and easier it will work, and the longer it will last. Because a big, rough, clumsy affair will enable you to do very decent work, there is no reason why you should be satisfied with such a tool; and this lathe may be made as well and neatly as any other, and gives you this advantage that it is easier by far to make this one well than one of the usual pattern badly. It is a job exactly suited to those who have little money and are not adepts.

It will, of course, be seen at once that this dead-centre lathe is only intended for work that can be supported at each end, and so it is primarily; we can't expect unlimited capacity in such a machine. But what an infinite number of everyday articles can be so made. Nine-tenths of an ordinary woodturner's work is of this kind. Table and chair legs, balustrades, bed-posts, drawer knobs, rolling-pins, towel rollers, rails, and uprights of towel horses, curtain poles, tool handles, handles and stands for many other purposes. All these can be, and are, turned between centres. So can chess men, and many other articles, and I shall presently show how the powers of this simple lathe may be increased so as not to leave even hollow work of simple forms an impossibility. But again I say it is not meant to be set forth as a rival of the more modern lathe, which is, of course, preferable where it can be had; but only as a simple, easily made, cheap and effective tool within certain evident limits;—a lathe which scores of our readers could make in a few days who could not make an ordinary one at all, and a lathe, moreover, on which metal can be turned as well as wood, provided it does not need to be bored. There is no need to describe the construction of the bed and its stand.

Let the former be not less than 6ft. if there is room in the workshop for it, as it is at least sufficiently tiresome to find oneself unable to turn a table leg or curtain pole, or other article of common use, because the bed is too short to receive it. It will not be necessary, though convenient, to make the axle of the flywheel of the full length of the bed, as it can be mounted on a short spindle between independent uprights, or more easily still upon a stud in the left-hand standard, in the same way as many of the small lathes are fitted in the present day. No cranked axle is then needed, and expense and trouble are thus spared.

The pulley A is the most important part of this lathe, and yet is often made very roughly. It revolves upon its bolt, and in reality takes the place of an ordinary driver-chuck used in metal turning, a carrier of some sort being placed on the work to gear with the pin, which projects from its face. It is in respect of this pulley, first of all, that I would suggest certain improvements upon the mere sheave of wood that is often used. To begin with, I would bush it with metal, preferably with steel, hardened, but most certainly with metal of some kind, to retard the wear of the hole in the pulley. Still, suppose this cannot be managed, it may be turned, or even sawn out of a bit of hard beech, elm, or oak, and used thus till a more elaborate one can be procured. It would, however, be a rare circumstance if a bit of tube of some kind could not be obtained, a slice off an old gun barrel or a bit of gaspipe, or some kind of ferrule which could be tightly driven into a hole bored to receive it. A bit of iron tube could be easily casehardened. An iron or

The Medical Annual and Practitioners' Index. London: Henry Kimpton.

THIS useful volume is primarily intended for the study table of the medical practitioner, but it will be of use to a larger circle, for, besides the list of societies and hospitals, it contains a medical gazetteer of the United Kingdom, sanitary memoranda, a list of hygienic homes, and brief descriptions of the health resorts of this country and the more accessible parts of the Continent. Of the purely professional parts of the annual we can say that "the year's work" seems well done, the selections being taken from the recognised organs of the medical world and carefully acknowledged; "the progress of pharmacy," too, will be welcomed by many busy practitioners, as it brings before them the names of any new drugs or pharmaceutical preparations introduced during the year, and similarly the list of new books will be found very useful. For these reasons we think the "Medical Annual" will be considered indispensable by the practitioner, and will be frequently referred to by the general public in search of the special information it contains.

Reed's Engineers' Handbook to the Local Marine Board Examinations. By W. H. THORN. Sunderland: Reed and Co.

THIS well-known work is now in its tenth edition, revised and enlarged, and is undoubtedly the best book that an aspirant for an engineer's certificate can purchase. Judging by the number of queries which reach us as to the method of getting an engineer's certificate, there is no lack of candidates for the post, and intending competitors will find all needful information in Reed's handbook, which contains not only the programme and rules of the examinations, but also the rules in arithmetic and the practical and technical matters on which the examinations are based. The plates and engravings in this volume are numerous, and leave scarcely any part of a marine engine undelineated. No one can sit for the examination who has not been to sea; but anyone who has served the required time, and gained some little practical knowledge, must be sadly wanting in intelligence if, after a diligent study of this work, he cannot gain a certificate as a second-class engineer.

We have also received the fifth edition of the *Natural Philosophy for General Readers and Young Persons*, by E. ATKINSON, Ph.D., F.C.S (Longmans), a work which is popularly known as the Smaller Ganot, and which, like that famous textbook of physics, is gradually growing in size and in public appreciation. In fact it may be described as *the* textbook of elementary physics. The fifth edition contains over 600 pages, nearly 500 illustrations, and a couple of coloured plates. ——*Transit Tables for* 1884, by LATIMER CLARK (E. and F. N. Spon), give the G.M.T. of the transit of the sun and of certain stars for every day of the year. The tables are prepared mainly for the use of those who, having little or no practical acquaintance with astronomy, are desirous of obtaining accurate time by means of the transit instrument. The directions and tables are sufficient, but readers unacquainted with the subject may be referred to Mr. Clark's "Treatise on the Transit Instrument," which we reviewed on p. 488, Vol. XXXV.——*Whitaker's Almanack for* 1884 (J. WHITAKER) is a wonderful compilation for the money, and is almost indispensable. In trying to do so much, the editor sometimes fails. We suppose a list of newspaper offices in London is useful, but that given on p. 456 is anything but satisfactory, for although the "E. M." appears, there are many important omissions, while the titles of several periodicals which are in no sense newspapers are inserted. The Scientific Summary for 1883 has been prepared without due attention to the relative importance of discoveries and inventions. ——*Photography Simplified* (Mawson and Swan) is a very cheap sixpennyworth, as besides giving brief directions for working the collodion process and dry plates, it contains a set of labels for chemicals, which will be useful to the amateur.——*Turning for Amateurs*, by Rev. J. LUKIN (L. U. Gill), is a new edition of a work which we need not recommend to our readers. To those who do not know the book or the author's writings, and are desirous of learning the art of working a lathe, we can say by all means purchase "Turning for Amateurs."——*The Chemical Effect of the Spectrum*, by J. M. EDER, (Harrison and Sons) is a reproduction from the *Photographic Journal* of Dr. Eder's brochure, translated and edited by Capt. W. De W. ABNEY, F.R.S. All scientific photographers will be glad to have these valuable notes in their present handy form.——*Calvert's Mechanic's Almanack* is, as usual, a valuable little "workshop companion."——*Amateur Work* (Ward, Lock, and Co.) is the second volume of a work which will be found of interest to amateur mechanics and artisans. ——*The Practical Ventriloquist*, by F. W. LOCKYEAR (Hart and Co.), is a little book that may be of use to those who aspire to be ventriloquists.——*Artistic Voice in Speech and Song*, by CHARLES LUNN (Baillière, Tindall, and Cox), is a brochure dedicated by permission to Sims Reeves, Santley, and Maas, in which the author shows very good reason for holding his own opinions in opposition to what he calls the pseudo-scientific works of Mr. Lennox Browne and Mr. Behnke.——*An Elementary Treatise on the Planetary Theory*, by C. H. H. CHEYNE, M.A., F.R.A.S. (Macmillan), is the third edition, edited by the Rev. A. FREEMAN, M.A., F.R.A.S., of a work which has been received with much favour, and may be recommended to students of mathematical astronomy.

PATTERN MAKING.—XX.

Miscellaneous Pipe Work.

COMMON pattern bends of uniform section can be very conveniently turned in the lathe if we want two bends of the same size. Jointing four pieces together at angles of 90° and screwing them on the face plate, we can turn the semicircular section with a templet in far less time than would be occupied with gouge and chisel and spokeshave, and with more accurate results (Fig. 112). Removing the four half patterns from the faceplate, we dowel them two and two together, forming two bends.

If the pattern is of a flat curve, as in the common "eighth" and "quarter" bends of the pipe makers (Fig. 113), or if it is a "reducing" bend, viz., a bend tapering from a larger to a smaller bore, the lathe is out of the question. In these cases we joint truly together two pieces of wood large enough to take the outline of the bend, each piece being thick enough to take half the diameter of the bend. We dowel them together, and on the joint face of one mark the outline we require. Cutting to these lines we obtain the longitudinal form, and working with gouge, chisel, and spokeshave, guided by a semicircular templet, we get the transverse section. We mark the outline of the second half from the one just worked, and cut that in turn with the half templet. Socket, bead, and prints are put on afterwards.

Some workmen have a way of cutting a bend, which, though slow, is safe, because there is no risk of undercutting. It is to work the stuff, first of all rectangular in section (Fig. 114), gradually into a polygonal form until a nearly circular section is attained (Figs. 115—116). The last remaining angularities being taken off with a spokeshave, a practically true circle is the result, which will not show wavy lines in the longitudinal direction. This is certainly the better method to adopt with a *reducing* bend, in which the diameter is constantly varying.

When the pattern is to form the elbow of a bend pipe (Fig. 117), it is required to attach the straight pieces of pipe to each end of the curved portion respectively. This we shall effect by means of a double dovetail, which is to be let into each of the portions of pipe which abut against one another (Fig. 118).

Sometimes pipes are made of very awkward shapes, to curve round parts of machinery, buildings, other pipes, &c. There may be two or three different bendings of the pipe not all in the same plane, and the flanges may have their faces at angles other than right angles. The pipe makers supply bends and S pipes of various shapes, by which the desired shape can often be pieced up; but where space is limited, or where a graceful outline is wanted, we make a pattern; and this opens up the question of loam work. In these and many other cases we want but one casting, and if the pipe is of large, or even of but moderate, dimensions, the pattern would cost a great deal more than the casting itself. Then the question of wood *versus* loam becomes one for our consideration. In large castings the answer must be in favour of loam in almost every case, and in small castings also it will usually be cheaper to strike up the pattern in loam. But in those awkward-shaped pipes such as Fig. 119, where the bends are not in the same plane, it costs less to knock out a rough pattern in wood than to strike it up in the foundry. Yet even in a case like this, if the casting were large, say over 6in. in diameter, loam would be the cheaper.

There are a number of "wrinkles" in the striking up of pipes in their various forms, so that a lad who had served his apprenticeship in a shop where no pipework was done would be "all at sea" on getting a start in a jobbing shop where pipes formed a part of the trade. So, beginning at the beginning, I will try to make the matter so clear that a pattern maker who had never seen a plain loam pipe made should be able to prepare his work successfully. In pattern making it frequently happens that though the parts which the workman has to prepare for the moulder's use are few and simple in form, they involve more technical knowledge than work of more pretentious appearance. This is especially the case in loam work. The parts the loam moulder requires are few and simple, and, like many other things, they are easily made —when one knows the way.

Let us commence upon the drawing. Fig. 120 represents the board, upon which we have drawn an S-pipe in longitudinal section. Observe that there is a line drawn parallel with one side of the pipe, and at a distance of ¾in. away from its edge. This is the "guide line." By this line the foundry-smith bends a piece of ½in. or ¾in. square rod, which becomes, as we shall see immediately, the "guide iron" (Fig. 121) for the "strickles." The strickles are the templets used for striking the transverse sections of the pipe in loam, and they have their edges cut in such a way that each strickle is maintained at its own proper distance from the guide iron during the process of striking. Thus, the guide iron being ¾in. away from the body, the body strickle (Fig. 122) will be notched up ¾in. from one edge of its 7in. semicircle. But the metal in the pipe being ½in. thick, the core strickle (Fig. 123) will be ¾in. + ½in. = 1¼in. wide at the shoulder. The edge of the strickle is chamfered like that of a loam board (Fig. 124). They are used thus: The guide iron is laid on a plate on the foundry carriage, and kept in position by sundry weights resting against it. Then the "check," as it is called, of the core strickle is set against the guide iron, and a semicircular body of loam is struck up (Fig. 125), following, of course, the contour of the guide iron. The iron is then turned over and fixed again in a new position, and a similar half-core struck up, but the reverse hand to the first. These are run into the stove and dried. When dry, the *pattern* strickle is set against the guide iron, and a thickness of loam struck over each half-core in turn. This also is dried; then both halves are detached from the plate, turned over joint to joint, and the rough pattern is complete. A little touching-up of the joints and a coat of tar will make it fit for the mould. When moulded, the thickness of loam representing the ½in. metal will be stripped off, and the core placed in the mould for casting.

If a flange is required for a loam-pipe, the hole in the flange will be of the same size as the core, and the body thickness of loam will be shouldered back to afford steadiness to it. Obviously, a socket end would not be formed with strickles very

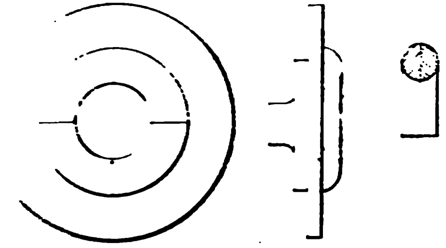


Fig. 112.

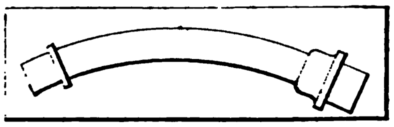
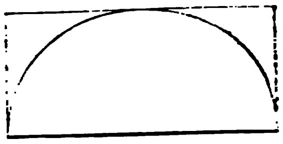


Fig. 113.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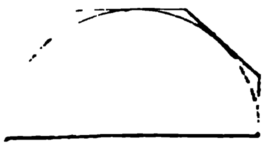
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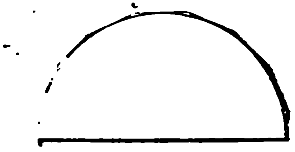
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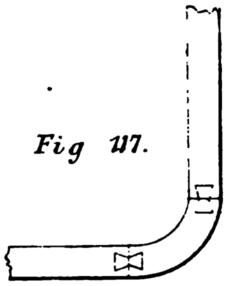
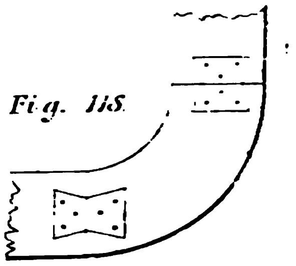


Fig. 117.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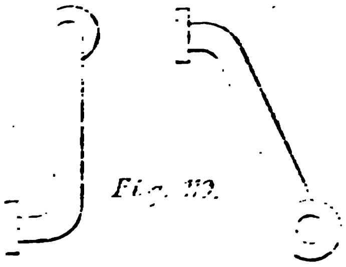
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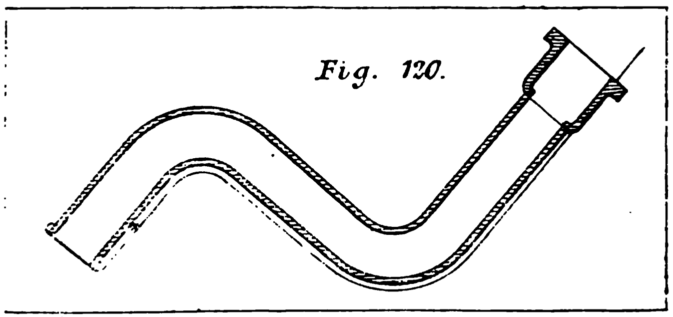
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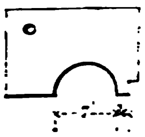
Fig. 122.

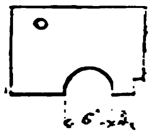
Fig. 123.

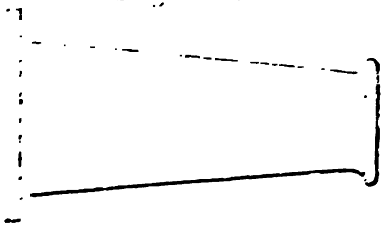
Fig. 126.

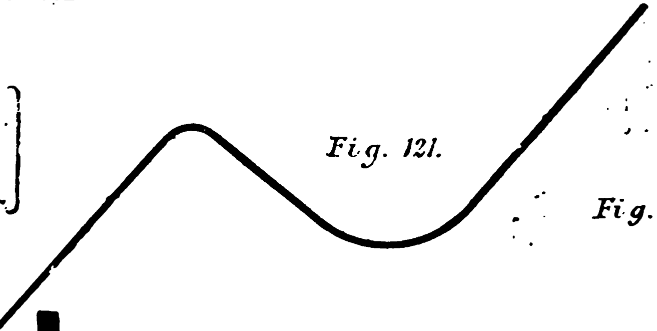
Fig. 121.

Fig. 124.

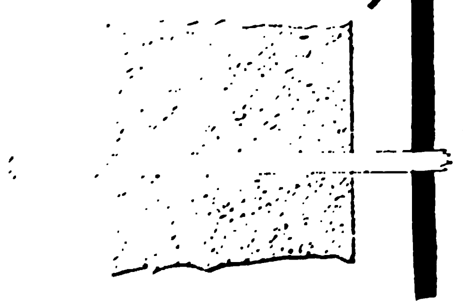
Fig. 125.

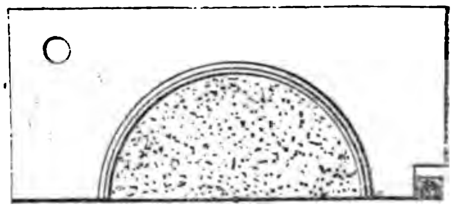
Fig. 125.

readily, on account of the dressing off where one diameter blends with another. So sockets are struck separately in the same way as a straight piece of pipe, to be afterwards sawn longitudinally down the centre and slid or threaded over the pipe body. They are held in place during moulding with nails. The socket core is treated in the same manner.

If we require pipes or hollow castings whose shape is not symmetrical, and which cannot, therefore, be struck on a revolving bar, or continuously by means of strickles, the difficulty is first, how to get the core of the proper shape; and then, how to insure an equal thickness of metal throughout. Take, for illustration, a reducing pipe connecting a rectangular valve box or pipe with one circular in section, Fig. 126. Except at the ends, the section is never uniform, so, except at the ends, a strickle or strickles cannot be used. So the core body is first roughed up and dried, then rubbed to its required shape with rasps and glass-paper. A number of strips are then prepared, of the same thickness as that of the pipe. These are laid on the core in various positions, lying flat, and their interstices are filled up with loam, which is strickled off level with their thicknesses. When the loam is set a little, but not baked, the strips are taken away, the vacant spaces filled up with more loam and dried. When moulded, the thickness is stripped off as before, and the core placed in the mould. By this method, castings of almost any size and shape can be made with uniform thicknesses of metal, and with much less trouble to the pattern maker than would be involved in making a core-box with templets.

THE DYNAMO: HOW MADE AND HOW USED—XI.*

By SELIMO R. BOTTONE.

§ 23. BEFORE winding the armature and field magnets with the wire in which the electricity is at once generated and conducted, it is necessary to fit together accurately the different portions, and *mark them*, so as to be able to put them together again in precisely the same position after winding; since no filing or fitting can be attempted on the castings after the wire has been wound without almost certain destruction of the insulation, and certain ruin to the neat appearance of the evenly-laid wire.

The part that calls for the greatest care and attention is the armature, which, as it must rotate in very close proximity to the poles of the field magnets at a rate varying from 1,000 to 3,000 revolutions per minute, requires to be centred most accurately on its bearings or trunnions. This to the possessor of a lathe presents but little difficulty; for the benefit of those who depend on ordinary tools only, the following method, by which the armature can be mounted on its bearings in a fairly accurate manner, is described. With a pair of calipers, the diameters of the two opposite extremities of the armature are taken, as shown at Fig. 18, *a* and *b*. (If the armature casting were finished up quite exact, these two measurements would be exactly alike, viz., a trifle under 1½in. each. But unless turned on the lathe, it is very rare to get such precision.) Two circles, of exactly the same diameters as the two extremities of the armature, are now to be struck out of a piece of hard sheet brass, ⅛in. thick, care being taken to mark the centre and the circumference in an exact and bold manner with the compasses. These circles will have to be cut out of the brass with a saw or file, so as to get two discs, fitting each one to its respective armature extremity; but before cutting out the circles thus marked, three should be drilled in each, viz., one in the exact centre $\frac{3}{16}$in. in diameter, which is to take the driving shaft or trunnion, and one on each side of this centre, $\frac{1}{8}$in. in diameter, to admit the screws which serve to attach these *heads* or discs to the iron portion of the armature. Besides these three holes, which are common to both "heads," another pair, also $\frac{1}{8}$in. in diameter, must be drilled in one of the heads, to allow the ends of the wire which is to be coiled around the armature to emerge from them, and pass through to the commutator. All these holes are shown *full size*, and in their correct position at Fig. 19, where *a* is the central aperture, to take the shaft: *b b* the two holes to admit the screws, whereby the heads are attached to the armature; and *c c*, holes drilled in one head only, to admit of the passage of wires to the commutator. These holes being bored, and the discs accurately cut out, two pieces of hard-drawn iron wire (not galvanised) $\frac{1}{4}$in. diameter and 2in. long, are carefully straightened, and by means of a screw-plate, a thread is put on one end of each. With the corresponding tap, a female screw is cut in the central hole of each brass disc. The two iron rods are then screwed in, particular care being taken that they enter perpendicularly, and centrally. They must be screwed in until they just protrude through to the other side; then the long end being allowed to slip between the jaws of a vice, while the disc rests flat upon the surface of the jaws, a few steady blows with a flat-pened hammer will spread the head of the screw end of the iron rod, so as to rivet it firmly to the disc, and thus prevent it working out. To render assurance doubly sure, a drop or two of soft solder may be run round the flat side of the end of the rod and disc. Now we come to a part of the work that very few amateurs can do at home—viz., drilling the holes in the faces of the armature. Any blacksmith will, however, do this for a few pence. Four holes are required, two at each end of the armature (one end is shown real size at *d d*), and these holes must be tapped with a female screw, so as to take the screws which serve to unite the whole together. It will be well be well to let the blacksmith drill and tap these holes to any-sized screw that he has nearest approaching $\frac{1}{8}$in. in diameter. Now will be also the time to get the blacksmith to drill the three holes, right through the top end of the legs and standard, which serve to allow these portions to be clamped together by means of bolts and nuts. These holes should be about $\frac{1}{4}$in. in diameter. Further details as to position and size will be given a little farther on. If our work has been properly performed, the heads may now be screwed down to the armature, with flat-headed screws, which should project about $\frac{3}{16}$in. above the level of the discs. Fig. 20 gives a representation of the finished armature about half the real size.

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Fig. 18.

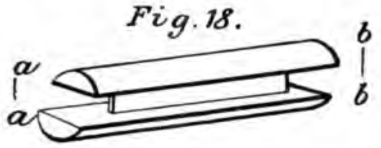


Fig. 19.

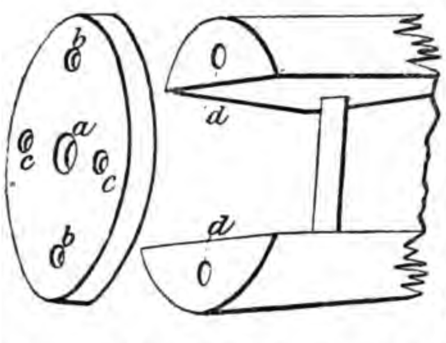
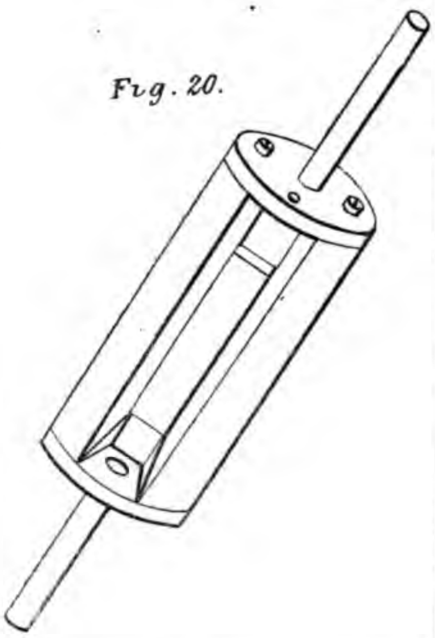


Fig. 20.



ON EYEPIECES.

By W. Bradbury.

If we may judge from various scattered particulars, it would seem that more care was exercised in the *design* of common eyepieces by the early opticians, than what appears to be the case in the present day. It is not, I believe, usual to employ any but plano lenses in common forms; whereas, in old eyepieces, the lenses had a variety of shapes. Whether any marked advantage attended their use may be doubted; still, it is unquestionable that these early artists must have found *some* benefit from the use of complex forms, or they would not have gone to the trouble of working such in place of simpler ones. But in those days of feeble competition, time, I presume, was of little value, provided a good result was got in the end. Nowadays "*Tempora mutantur et nos mutamur in illis.*" The trade workman must use that method which, in the least time, will give a result up to the standard required by his customers.

I am indebted to Brewster's "Ferguson" for the subjoined particulars which relate to early forms of eyepieces. He says:—"In order to correct the error arising from the unequal refrangibility of light in the *eyepieces* of telescopes, we are not under the necessity of using compound lenses of crown and flint glass, as this species of aberration can be completely removed by a particular arrangement of the eyeglasses which are employed for erecting the object. In small pocket telescopes, as opera-glasses, &c., where it would be very inconvenient to apply a long eyepiece, compound lenses of crown and flint glass should be adopted, and may consist either of two or three glasses with the following curvatures:—

Doublets.

I.	Crown lens, equi-convex, radius	·320, focus ·304
	Flint lens, equi-concave, radius	·529, focus ·438
II.	Crown glass, equi-convex, radius	·320, focus ·304
	Flint lens, double concave, radii	·320, focus ·438 1·517

TRIPLETS.

I.	Crown lens, equi-convex, radius	·640, focus ·608
	Flint lens, equi-concave, radius	·529, focus ·438
	Crown lens, equi-convex, radius	·640, focus ·608
II.	Crown lens, double convex, radii	·810, focus ·608 ·529
	Flint lens, equi-concave, radius	·529, focus ·438
	Crown lens, double convex, radii	·529, focus ·608 ·810

If it is required to erect the object as in the Galilean telescope, the middle lens of flint glass must be convex and the other lenses concave, but with the same radii, so that the concavity of the compound lens may predominate.

The following table for arranging a three-lens eyepiece is given. Let F = focus of o.g., and x, y, z foci of eyeglasses, reckoning from tha which is nearest the object:—

1. Distance between first and second lenses	$x +$
2. Distance between second and third lenses	$y + z + \frac{y^2}{x +}$
3. Distance of first lens from focus of o.g.	$\frac{xy}{x + y}$
4. Magnifying power of eyepiece	$\frac{Fy}{xz}$
5. Focus of a single lens of the same power	$\frac{x}{y}$
6. Distance from the eye to the third lens	z
7. Length of the whole eyepiece	$x + 3y + 2z$
8. Length of the whole telescope	$F + x + 3y + 2z$
9. Aperture of the lenses a, a', a''	$a = \frac{xa'}{y}$
10. Aperture of diaphragm (m) placed in focus of o.g., should be a little less than	a
11. The field of view is nearly....	$\frac{\cdot 3438\, m}{F}$.

The apertures of the lenses may be equal to one another, but should never be greater than half the focus of the third lens.

"Although the aberration of colour will be completely removed by making the lenses of any focal length, and placing them at the distances indicated by the preceding formulæ, yet it is preferable to make the first and second lenses of the same focus, and to give the third a less focus, and make its distance from the second equal to its own focus, added to $1\frac{1}{2}$ the focus of one of the other lenses. Besides the simplicity of this combination, it has another advantage, for the magnifying power of the e.p. is always equal to the magnifying power of the third lens. So that in this construction, when we wish to give a certain magnifying power to a telescope, we have only to take such a focus for the third lens as will produce this magnifying power, and make the focus of the other two a little greater than that of the third. By increasing the foci of the two first lenses, the image is not injured by any particles of dust which may be lying on the surface, and the spheric aberration is also diminished. By augmenting the curvature of the third lens, however, we contract the field of view, which ought, if possible, to be avoided. This may be avoided, indeed, as Boscovich has shown, by making the third lens consist of two convex ones of the same glass, their surfaces being in contact and their foci equal. From long experience he found that eyepieces of this construction are superior to all others, and that the error arising from the spheric figure of the glass is greatly diminished by making all the lenses planoconvex and turning the plane sides to the eye, excepting the second lens, whose plane surface should be turned to the object. All the lenses may be made of the same foci, and then the distance between the first and second and second and third will be equal to the sum of their foci. In this case the third and fourth lenses, which are joined together, are considered as a single lens, whose foci is equal to one-half the foci of either of the two.

"In all kinds of achromatic eyepieces composed of single lenses flint glass should be employed, because it has the greatest refraction, and therefore requires a less curvature to give the same foci. The spheric error, consequently, which always increases with the curvature of the lenses, will be less in a flint glass eyepiece. Flint glass, indeed, produces a greater separation of colours, but the error arising from this cause is completely removed by the proper arrangement of the lenses."

"A good achro. e.p. may be made of four lenses" arranged as follows, starting from the lenses next the object:—Foci as 14 : 21 : 27 : 32; apertures 5·6 : 3·4 : 13·5 : 2·6; distances, 28 : 44 : 40. Size of stop in front focus of 4th lens, 7.

Eyepiece of a Ramsden telescope, 8·5in. focus; power, 15·4.

Foci, 0·77 : 1·025 : 1·01 : 0·79; distances, 1·18 : 1·83 : 1·10 (inches and decimal parts).

Dollond's four lens e.p. in the Duc de Chaulnes telescope (measured in lines and decimal parts):—Foci, 14·25 : 19 : 22·75 : 14; distances, 22·48 : 46·17 : 21·45; thicknesses 1·23 : 1·25 : 1·47.

Fourth lens plano-convex, plane side to the eye; the rest double-convex lenses.

Two astro e.p.'s belonging to the same telescope: the first a micrometer e.p.

and it is then brought into exceedingly shallow water and the operation of disconnecting the various sections proceeded with. To each section, while still afloat, will be secured four large light steel wheels, having very wide tires. This being done, the divisions are ready to be hauled out of the water and over land, and what was once a section of a boat now becomes the body of a waggon, of ample capacity to convey the lighter portions of machinery, stores, &c. On arriving at the next navigable part of the river these impromptu wagons are run into the water, the wheels are removed, and the various divisions re-united, forming again an entire vessel. Between the mouth of the Congo and Stanley Pool there are six cataracts, which will necessitate the vessel being taken to pieces, in order to avoid them. The trial on Saturday was most successful, the steering capabilities of the steamer being much admired. The mean draught was 14in. in working trim, and with a steam pressure of 100lb. per square inch a speed of 9½ to 10 miles an hour was obtained. On the deck is a small saloon, which has squares of netting instead of panes of glass—the ventilation being adapted for a tropical climate—and the steering wheel is placed high up on a bridge, some 12ft. above the water, giving the pilot a good view all round.

GEOMETRY IN THE FOUNDRY.*

IN nearly all trades some knowledge of geometry is required. For the moulder no one seems to have written up that which is applicable to his trade. Some may wonder what moulders want geometry for, and think if we understand the use of shovel and rammer it is all we need. This, in many cases, may be true. But often a knowledge of geometry can be turned to as good an account in our trade as in others. It is as essential that many moulders should understand geometry as it is that pattern-makers should do so. The way it now is the pattern-maker generally does our geometry for us; and we, through our ignorance, are forced to submit to other tradesmen, to our own detriment. In green sand, as well as in loam work, moulders are often obliged to call the pattern-maker to explain or to mark out work that requires geometrical knowledge. Mounds are often made requiring the dividing of circles, or marking off of square, oblong, and other shapes; locating of flanges, lugs, or sections of patterns, &c. The lack of geometrical knowledge is often woeful. I remember a case where a moulder was sent for the radius to describe a circle, and returned with a pattern segment. When questioned he said the pattern-maker was absent, and as the segment was upon his bench he thought that was the thing wanted.

To describe a circle is a simple affair. To divide one into any number of equal parts is where a knowledge of geometry is found useful. The number of parts into which a circle can be most readily divided is six, because the distance from the centre of any circle to its circumference, as B, A, Fig. 2, will divide the circumference into six equal, parts, F, D, A, P, E, and S. To divide the circumference into three, take out every other one of the six points. To divide it into twelve equally, divide each of the six parts. To divide it into four parts describe a line through the centre, as K, O, Fig. 3. From the points where X · O intersect the circumference, with trammels or dividers set at more than two-thirds the diameter describe arcs cutting each other, as at N. A line drawn from N through the centre divides the circle into four parts. For eight parts bisect each of the four. Many divide the circle into four parts by the use of a square, instead of by describing the arcs, as at N.

The division of circles into odd, or even equal, sections can be done as follows: At H and R, Fig. 4, the radius, or one-sixth of the circumference, is set off. This radius then divided, by trial, into the number of sections required. With the trammels or dividers set to the chord of six of the parts space off the circumference. This will divide the circumference into the same number of sections as in the radius. Should it fail to do so the fault is yours. It must be remembered that to *exactly* divide the circumference requires very fine manipulation. There are but few men who can go around the circle twice, and come out exactly alike.

One-tenth, one-ninth, one-eighth and one-seventh are simply shown to further illustrate the rule. To obtain one-fifth, the radius is divided into five, and, in order to have the six points, one is added to the radius length as shown. If by this rule the circle was to be divided into four equal sections, the radius chord would be divided into four sections, and, in order to have six points, two would be added to the length.

For the divisions of circumference into small parts for the purpose of gear-making, &c., rules implying mathematical calculations are required. The plan here given is such as requires no figures, and can often be used by the moulder to good advantage.

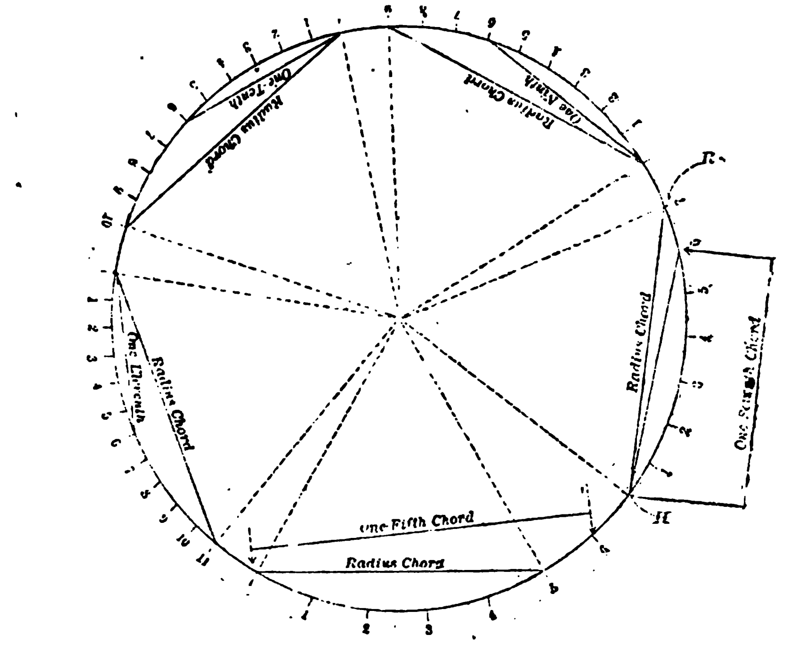


Fig. 4

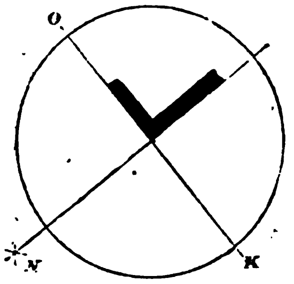


Fig. 3

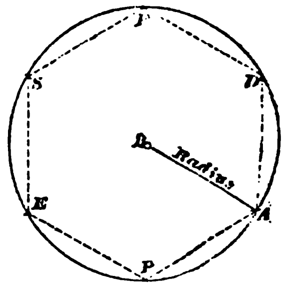
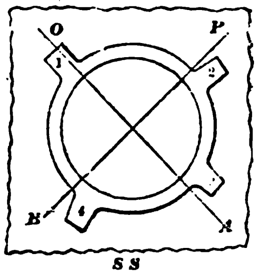
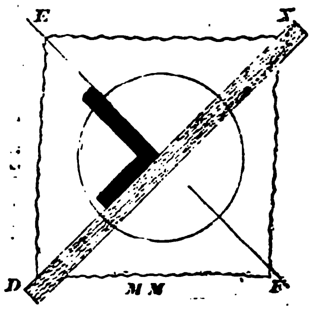


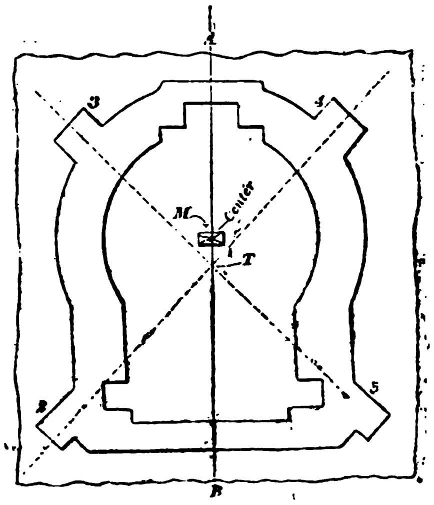
Fig. 2



S S



M M



Cylinder Plate

In loam moulding plates are required that in the hands of some moulders will be made without any visible shape of pattern, while others will require almost a full pattern. There are some loam moulders who can make any number of loam plates and rings entirely from the drawings and not have a mistake in the lot. To be able to lay out a lot of rings and plates, and have them all come right, requires one to understand the reading of drawings and a few of the elementary rules of geometry, besides sound judgment.

In marking out upon a sand-bed for any ring or plate having irregular shapes, a centre line to work from is required, the same as the draughtsman as-quires in making a drawing. The cut showing a cylinder plate ring will to the novice convey ideas of laying out that may be useful. The bed being made, the first thing done is to drive a centre stake M. In this stake is made a small hole, for the dividers or trammels' point. Crossing this centre is marked the centre line A B. From this line all right-angle lines and measurements are taken. The circular lines being described, the next to follow is marking and locating the lifting handles 2, 3, 4, and 5. This often requires careful consideration, that they may be placed in the best position to insure or assist the mould being balanced when hoisted up. In locating lifting handles upon square or round plates, they should, as a general thing, be set square with each other. This will be better understood by referring to the cuts M M and S S. In M M the square and straight edges seen show the manner of squaring off the bed. The straight edge having its edge over the centre, the square is set against it, so as to have it lay at right angles from the centre; the lines D, E and X are then described, after which the square and straight edge, are removed. The straight edge then being laid alongside of the line E, the line is carried through to F, thereby squaring off the bed.

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* By Thos. D. West in the American Machinist.

In the cut S S, the lines O, P, A, and B describe the square, while the handles 1, 2, 3, and 4 are out of square. The objection to such random dividing of handles is they will not come plumb under the lifting cross, which is usually made square. Also, handles thus placed upon rings, square or round plates, do not make them uniformly carry their load, thereby giving them a chance to spring and cause the mould to crack. Some may say that they are often compelled to locate handles out of square to make them balance their load. This may be true in some cases, but, when possible, instead of distorting the square, the centre point should be moved to where the best judgment points out will be the mould's balancing centre.

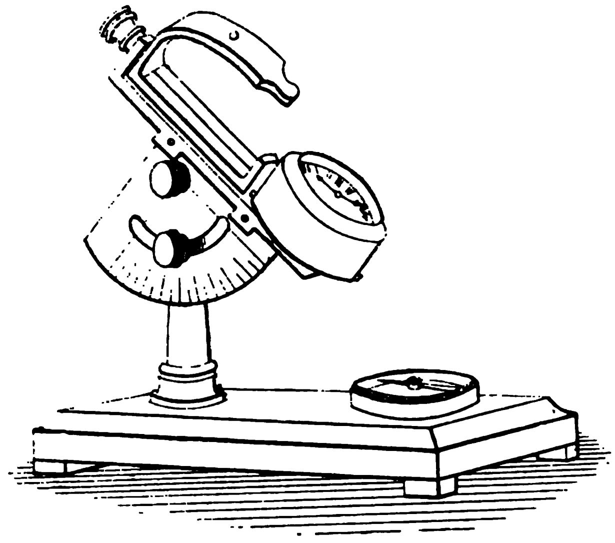
To illustrate this idea, instead of having the cylinder plate shown squared from the centre, square it from T. This, while it does not distort the square of the handles will bring the balancing point wherever desired.

Sometimes plates are required oblong. This does not always call for the handles to be set oblong. If necessary handles can be set square upon an oblong plate as well as upon a round or square one, as long as the lines are at right angles to each other; coming towards the centre does not alter the square. Of course, it is not here advocated to set handles square at the sacrifice of oblong plates being sprung when their load comes upon them. The thing is to understand what is best, and then be able to do it.

Improperly placed handle have been the cause of much trouble in adjusting and balancing moulds, and have caused many moulds to crack. This fault, and other faults, are not so much from carelessness as from the want of a little geometrical knowledge. There are but few loam moulders who, from a drawing, are able to order their sweeps, &c., and make the jobs required. Our trade demands something higher than loam daubing and shovelling sand, and he that tries for the highest cannot but find himself benefited.

A NEW SOLAR REGULATOR.

AMATEURS and owners of country seats who like to consult the hour by the sun, and are satisfied with but relative accuracy, have long needed an apparatus that had a neat appearance externally and was easy of management. This want is now supplied by the solar regulator, an apparatus constructed according to data furnished by its inventor, M. Corneloup, a manufacturer of clocks. A description of the apparatus will be easily understood by the aid of the annexed figure, which represents it half the actual size. Upon a pillar carried by a quadrangular base there is mounted a support which has its extremities bent at right angles, and which revolves in a vertical plane and on a centre at which ends the apex of a graduated sector. This latter gives the measurement of the inclinations that the support can take, and which should always correspond to the latitude of the place. The sector, having been brought to the proper point, is fixed by means of an adjusting screw. At the base of the support there is fixed a small case which is provided with a dial and hands. The style, and the plate upon which the noon line is traced, are independent. The plate pivots between the two upturned extremities of the support. Upon the prolongation of the lower pivot, which enters the dial case, there is adjusted a pinion which, through the intermedium of wheel work, causes the hands to revolve. A compass fixed on the base of the apparatus serves to place it in proper position. The instrument is regulated when the aperture in the style, the solar noon line, and noon as shown by the hands on the dial are exactly in the same vertical plane. The instrument having been regulated, it will be only necessary to incline the style to the right or left so as to bring the luminous point upon the noon line; and, as the hands will follow its motion, the hour will be read upon the dial. While travelling, the owner may regulate the apparatus by the aid of a good watch, having seconds hands, which has been set by observatory time, or by the aid of a good chronometer. The instructions that accompany the instrument indicate the inclination to be given the sector to make it correspond with the latitude. What will bring this little apparatus into favour with amateurs is the fact that, unlike the sundial, which is always fixed, it may easily change place, and the hour be read upon it just as is done with a watch.—*La Nature.*



HOW A BONE IS BUILT.

A LECTURE on this subject was delivered at the London Institution last week by Mr. Donald M'Alister, of St. John's College, Cambridge. In introducing the subject, the lecturer explained that he would treat the construction of a bone as a question of architecture or engineering rather than of anatomy. In looking at an ordinary marrow-bone two points would strike one. In the first place, the shank or shaft of the bone was hollow, forming a somewhat thin-walled tube; secondly, the end of the bone next the joint appeared on section to be not hollow but filled with a spongy or "cancellous" meshwork of bony tissue. The tube-form appeared not only in bones, but in many other structures characterised by combined lightness and strength—such as the stalks of plants, seeds, bamboos, quills of feathers; and among human constructions in a vast variety of shapes, from tubular bridges to backbones of bicycles or tricycles. What was the common principle underlying all these manifold varieties? Why was it that, weight for weight, a hollow column was so much stronger than a solid one? The lecturer then showed that when an ordinary rectangular cross-beam was slightly deflected by a load, the upper fibres were in a state of compression, while the under fibres were in a state of tension; whereas in the middle of the beam there was a neutral region neither compressed nor stretched. For load-bearing purposes this region might be removed: the beam would thereby be made appreciably lighter but not appreciably weaker. The tube-form of a bone was thus due to the fact that the material was concentrated at those parts which were most under strain and where it was most useful; it was removed from those parts where it added to the weight without adding to the strength. Tables were exhibited from which it appeared that bone in its physical properties resembled steel much more than such a material as cast-iron. Bone, like steel, was almost as strong to resist tearing as to resist crushing. The spongy or cancellous ends of bone were next considered, and by photographs of actual specimens the lecturer showed that the apparently confused and irregular character of the tissue resolved itself on examination into a very beautiful and harmonious regularity. In the construction of such great structures as the Forth Bridge and the large cranes seen at the docks, engineers had found it useful to investigate the lines of the structure along which the pressure or the tension was at a maximum; the lines might be called stress-lines par excellence. The material at disposal was most economically arranged when it was concentrated along these lines, leaving empty the mesh-like spaces corresponding to the neutral region of a cross-beam. A skeleton or lattice frame-work might thus be built up, having all the strength of a solid structure of the same shape or loading, but with much less expenditure of substance. Such a structure would, moreover, be free from the danger of giving way by "shearing" or "faulting" in the geological sense. In other words, its parts would have no tendency to give way by sliding or slipping over each other; they could only be directly crushed or directly torn asunder. This was, therefore, an ideal mode of building such structures, and it was only because skilled workmanship was more expensive than material that engineers did not oftener put it into practice. In bone building, the lecturer said, there were no such obstacles in the way of perfect construction, and in such a part as the head of the thigh-bone the principle was carried oui in ideal perfection. The cancellous network in this bone was a material embodiment of the engineer's ideal lattice-work of true stress-lines, so much so that in the Zürich School of Engineering thin sections of the thigh-bone were placed before the pupils as the best possible illustration of the true principle of construction. In conclusion, the lecturer remarked that when such instances of adaptation as appeared in the eye and hand, and, perhaps, he might now add the common marrow-bone, were brought before us we were filled with wonder, and some saw in them evidences of what was called direct design. These evidences might nowadays be interpreted in perhaps a worthier and grander sense, but the wonder would remain for all who had eyes to see. At any rate, apart from all teleology, and taking only the strict architectural sense of the words, we must agree that a marrow-bone was well and admirably designed.

CROTON OIL.

THE investigations of Mr. Harold Senier, Fellow of the Chemical Society, into the active principles of croton oil are not without considerable interest to the physician. Mr. Senier read to the Pharmaceutical Society on Dec. 5th a paper in two parts—one on the vesicating principle in croton oil, the other on the purgative principle in croton oil. In 1878, in a former paper, he gave the results of an investigation into the action of alcohol on croton oil, and showed that under certain conditions it separated the oil into two parts—the one part vesicating, the other non-vesicating. The non-vesicating oil Mr. Senier has since shown to be purgative. The conditions referred to are that the alcohol shall be of specific gravity ·794 to ·800, and in the proportion of seven volumes to six, or any larger proportion. If the alcohol and oil are mixed in equal volumes perfect solution takes place, and this holds of a mixture with any less quantity of alcohol. But when the volume of alcohol exceeds that of croton oil, a part of the croton oil separates. This part varies in quantity in different samples of the oil. The part so separated is afterwards insoluble in any proportion of alcohol. But that portion of oil dissolved by alcohol is, when separated, soluble in all proportions. Mr. Senier has found that the part soluble in alcohol as above used was, or contained, the vesicating principle, and that the vesicating activity does not exist in the free acids, nor in any basic constituent, but resides in the combined non-volatile fatty acids. Mr. Senier further finds that the purgative constituent does not reside in the alcohol-soluble vesicating oil, but entirely in the alcohol non-soluble, non-vesicating oil. In support of this conclusion he refers in his paper to experiments on himself and others. He further says that the conclusion is borne out by a study of the therapeutic action of this non-vesicating oil by Dr. J. W. Meek. The general result of these experiments

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ON "OPTICAL TUBE LENGTH" AN UNCONSIDERED ELEMENT IN THE THEORY OF THE MICROSCOPE.

By [illegible] Sec. R.M.S.

It is a little strange that at this late period in the development of the microscope an element [illegible] the theory of the microscope.

[illegible]

[illegible] the matter it will be [illegible] in regard to magnifying power.

[illegible] of a lens depends, of [illegible] and varies inversely with it: the ordinary mode of obtaining the power being to divide the distance of distinct vision l (assumed as 10in.) by the focal length, or expressing it by a formula $N = \frac{l}{f}$. Thus, if the focal length f of an objective is ⅛in., 10 ÷ ⅛ = 80. The same applies to the action of the microscope as a whole—that is, with eyepiece and objective combined. When we have determined its focal length we similarly obtain its magnifying power.*

We have, therefore, to ascertain the proper mode of determining the focal length f of the entire microscope, having given the focal length f^1 of the objective and the focal length f^2 of the eyepiece.

The usual assumption hitherto has been that f is determined by multiplying f^1 and f^2 together and dividing by the length of the tube 10in., or—

$$f = \frac{f^1 f^2}{10},$$

so that if we had an objective of ⅛in. and an eyepiece of 2in. the focal length of the microscope—

$$f = \frac{\frac{1}{8} \times 2}{10} = \frac{1}{40}.$$

A microscope of a focal length $\frac{1}{40}$in. would magnify 400 times, so that if this method of arriving at the focal length of the microscrope were correct, we should only have to multiply the power of the ⅛in. objective (80) by that of the (2in.) eyepiece (5), to have the total magnifying power (400), the brass tube being assumed to be constant at 10in.

The fallacy of this method lies in the fact that the true formula is not—

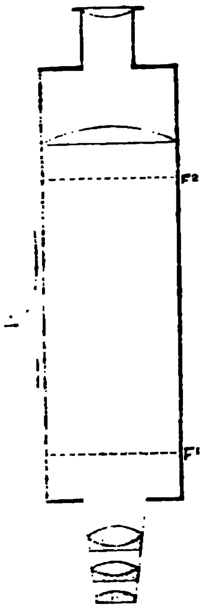
$$f = \frac{f^1 f^2}{10},$$

but—

$$f = \frac{f^1 f^2}{\Delta}.$$

Δ being the distance between the posterior principal† focal plane of the objective and the anterior principal focal plane of the eyepiece, or, as Professor Abbe terms it, the rational or optical tube-length, in contradistinction to the mechanical or physical length.

The accompanying Fig., where F¹ is the posterior focal plane of the objective and F² the anterior focal plane of the eyepiece, will illustrate this more clearly.



As Δ is the divisor of the fraction which represents the focal length, the latter is, of course, larger or smaller according as Δ is smaller or larger, that is, it varies inversely as Δ; and as the magnifying power is inversely to the focal length, the magnifying power varies directly as Δ, which is therefore seen to be a fundamental factor of microscopic amplification.

We can now see how it is that two objectives of the same focal length may yet give different magnifying powers with the same tube and eyepiece. By the different methods of construction adopted by their makers, the focal plane of the one objective may be further off the back lens than is the case with the other. The distance Δ between the focal planes of the objective and eyepiece will be correspondingly diminished, and the focal length of the whole microscope increased. The magnifying power will therefore be diminished.

Again, take the case of an objective of, say, ⅛in. and 1in. focal length used with the same eyepiece (2in.) and tube. If the difference Δ remained constant, say 10in., the total focal length would vary with that of the objectives,

$$f = \frac{\frac{1}{8} \times 2}{10} = \frac{1}{40}, \text{ or } f = \frac{1 \times 2}{10} = \frac{1}{5}.$$

But the posterior focal planes of the two objectives instead of coinciding may have different positions, every variation producing, of course, a change in the value of Δ. With the ⅛in. objective the posterior focal plane will be very near the back lens, and we have a long Δ: with a 1in. objective its posterior focal plane may be further from the back lens (higher up the tube), and we have a diminished Δ. We might have the ⅛in. objective Δ = 10in., and a power of (80 × 10 =) 800, but with the 1in. objective we should not have (10 × 10 =) 100, or a total power in proportion to the powers of the objectives. Δ might be 8in. only instead of 10in., and the total power would be only 80.

The converse case of different eyepieces with the same objective is similarly explicable. The anterior focal planes of the eyepieces may be at different points of the tube, and we shall have a varying Δ.

As to the general character of the variations in Δ, it may be noted that the position of the anterior focal plane of the eyepiece does not vary very much in the Huyghenian form: a substantial difference is, however, found in this respect between the Ramsden and Huyghenian, the former having its anterior focal plane at some distance below the field lens, and the latter above it. With the objective, however, a very wide range is possible. Its posterior focal plane may be (1) some distance above the last surface of the objective; (2) close to this surface outside or within the objective; or (3)—though a more exceptional case—as a virtual focus below the stage or even below the table. Practically, however, with objectives of ordinary construction the difference in position of the posterior focal plane is not great with powers higher than ⅛in., and it is only when we come to the lower powers that the difference is a substantial one.

Greater differences in the power will also be found with short tubes than with long ones. With a 10in. tube a difference of 2in. reduces the 10 to 8, but with a 6in. tube from 6 to 4—quite different percentages of variation.

The process, therefore, of multiplying together the powers of the eyepiece and the objective to obtain the total power of the microscope is a fallacious one, as it supposes a constant tube length; whilst, as we have seen, the true tube-length varies with the different objectives and eyepieces used.

To determine the power of the microscope from the powers of the eyepiece and objective, it is necessary, in addition, to know the position of the focal planes of each of the latter. How these may be readily determined must be deferred for a subsequent occasion.

[illegible] Microscopical Society.

[illegible] it to Dr. Dippel, [illegible] edition of "Das Mikroskop."

* The quotient obtained by dividing 10in. by the focal length gives the linear amplification of an image—real or virtual—which is projected by an objective to a distance of 10in. [illegible] and not from the objective, as has been so commonly assumed.

† The principal focal planes are the planes passing through the point on the axis in which parallel rays coming from the opposite side of the lens are brought to a focus. "Anterior" and "posterior" are used in reference to the direction in which the rays come to the observer.

ALCHEMY AND MODERN SCIENCE.

CONTINUING his course of lectures to juveniles (see p. 382) Prof. Dewar, F.R.S., said they had now reached the epoch of the Greek philosophers. They were in the front rank of the intellectual teachers of mankind, inquisitive and acute searchers after truth, deep thinkers, and earnest students. Their *forte* was ingenious and profound speculation which they extended into the most intricate regions of metaphysics. But notwithstanding their excellent mathematical training they did not seem to have been at home in describing matter and studying physical problems. From the very earliest ages the doctrine that the world of visible things is made up of the four elements, earth, air, fire, and water, was current. No sooner, however, did Greek philosophy begin to grapple with the question than attempts were made to simplify the explanation. About B.C. 600 Thales taught that water was the primordial element, in opposition to whom Heraclitus held that it was fire, and others that it was air or even earth. The current idea of matter was that it was built up of infinitely small particles, all homogeneous and endued with motion. It was this necessity of motion that led Heraclitus to make fire the primary element. The dance of atomi in the void was illustrated on the screen. In a general way the notion of the four elements held its ground during 25 centuries. Aristotle introduced a fifth element — ether, as a vehicle for the transmission of light among the heavenly bodies. The Greek philosophers were not great at experimenting. Even the famous experiment of Archimedes for testing the purity of the gold used in making the Sicilian king's crown belonged to physics rather than to chemistry. Between Archimedes and the beginning of our era a real hygrometer was devised, but the invention was lost before Pliny wrote, since he never mentioned it, and it was not re-invented until about 1,600 years afterwards. The Roman emperor Diocletian ordered all writings on alchemy found in Egypt, including those in the great Alexandrian library, to be burnt, lest by a resort to the occult science the Egyptians should grow too rich and should rebel against him. Meanwhile, the great discovery of the famous Greek fire not so very long afterwards proved that the knowledge of chemical science had by no means wholly died out. The lecturer said it was probably a mixture of petroleum with sulphur and nitre—in fact, a rude sort of gunpowder. To the great delight of the young folks, he extemporised a kind of gunpowder, which exploded in quite orthodox style. Coming down to the Mohammedan conquest of Egypt, he showed the survival of the chemical tradition in the Arabic records. Representations of the apparatus used by the alchemists, their retorts, crucibles, and alembics, taken from these authoritative sources, were reproduced on the screen. The vessels were mostly those employed in the important process of distillation. In explaining this process, it was demonstrated by a beautiful experiment, how greatly ebullition is hastened if the water contains air. In like manner the insertion of a single tiny crystal in a saline solution brought about, almost instantaneously, the crystallisation of the entire mass.

USFEUL AND SCIENTIFIC NOTES.

The Manufacture of Buttons.—It is a curious fact that although the button trade of New York is estimated at from 8,000,000dols. to 10,000,000 dols. per annum at the American rate of wages, many of the imported buttons could not be put upon their cards for the price they sell for. Europe is still the great seat of the button manufacture. Glass buttons are chiefly made in Bohemia, where children are largely employed. The children get 10c. a day, women from 30c. to 40c., and men from 40c. to 50c. Pearl buttons are almost exclusively a Vienna product; but shirt buttons are chiefly made in Birmingham, which is also the seat of the metal button trade. But the most extensive of all the button manufacturing is that of the Parisian and Berlin novelties. In one manufacturing village near Paris, containing from 5,000 to 6,000 inhabitants, all the working people are engaged in making agate buttons, which, even with 30 per cent. duty added to the cost, sell, when imported into America, at about 31c. per great gross. It is stated that the material alone could not be produced in the States for double that amount. Yet while American manufacturers make no attempt to compete with European producers employing hand processes, they excel in making bone, composition, brass, ivory, and gold buttons by machinery, and are able to export considerable quantities of these goods. For example, in Providence, Rhode Island, sleeve buttons and jewellery buttons are largely manufactured for exportation.

Longevity in the United States.—A further volume in connection with the tenth census of the United States has just been published. It gives separately and distinctly for every State the population from one year and under, to every 100 years and over. By taking in each State the number of the very aged, that is of those from 90 to 100 years and upwards, and finding how many times it is contained in the total population, the interesting result obtained is, that the proportion of the very aged to the total population is greatest in the Southern States. Louisiana stands at the head of the list in regard to extraordinary cases of longevity, Mississippi comes second, and Alabama third. The rest of the States come in the following order:—South Carolina, Florida, Georgia, North Carolina, Virginia, Tennessee, Texas, Arkansas, Kentucky, District of Columbia, Maryland, California, Delaware, Nevada, Colorado, West Virginia, Missouri, Vermont, New Hampshire, Ohio, Rhode Island, Indiana, New York, Michigan, Pennsylvania, Massachusetts, Wisconsin, New Jersey, Minnesota, Illinois, Oregon, Kansas, Maine, Connecticut, Iowa, and Nebraska. It is demonstrated, for example, from the tables that there are proportionally to the total population, nine times more of the age of 100 years in Alabama than in New York, and 15 times more than in Maine.

Interesting trials were made last month—December—by the telegraph engineers to the German Government in substituting a Siemens and Halske dynamo-electric machine for voltaic batteries. From the 4th to 7th December inclusive the current was sent simultaneously through from fourteen to eighteen lines with excellent results. Very powerful batteries had before been required.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE third meeting of the session of the above society was held on the 12th ult., at King's College, Strand, James Glaisher, Esq., F.R.S., vice president, in the chair.

The chairman said it was his painful duty to announce that since their last meeting the death had occurred of one of their members, who during almost the whole of his life had been held in the highest esteem and respect by all microscopists. He referred to Mr. Hugh Powell, of the firm of Powell and Lealand. It was truly a ripe old age to which he had attained, but, nevertheless, it was always painful when at length the time of parting came, and both as a society and as individuals, he was sure they must deeply regret the removal of one whom they had always held in such respect. It was by an unfortunate coincidence that it fell to his lot to announce to the same meeting the death of Mr. Powell's most distinguished rival in America—Mr. R. B. Tolles, of Boston—who had also done so much for the improvement of objectives. Peace be to both of them; with the kindliest feelings of sympathy towards their respective families of every Fellow of the society.

Mr. Crisp exhibited Mr. H. P. Aylward's microscope, having a swinging tailpiece rotating completely round the stage, so that the mirror and sub-stage could be set in any required azimuth.

Mr. Crisp also exhibited (1) a microscope by Mr. A. McLaren, which was made to rotate upon the horseshoe foot, so as to secure greater stability to the instrument when the body was inclined at any considerable angle; (2) a microscope by F. W. Schieck, with a number of objects inserted in the circumference of a revolving drum, so that each could be passed in turn beneath the objective. A translation of the inventor's description of the instrument and its advantages was read to the meeting, and his claim to absolute originality shown to be erroneous by the exhibition of Harris's microscope, obviously of considerable age, in which the same idea had been carried out.

Mr. W. H. Walmsley's photo-micrographs were exhibited, two of which in particular (of Möller's diatoms) were characterised by the Chairman as very excellent examples of photo-micrography.

Mr. W. M. Bale's note on Mounting in Glycerine was read.

Dr. J. H. Flögel's paper "On Researches on the Structure of the Cell-walls of Diatoms" was brought before the meeting by Mr. J. Mayall, jun., who, in his preliminary remarks, said that it would be remembered that some time ago they had heard reports that someone abroad was making sections of diatoms, and he was requested by Mr. Crisp to institute inquiries with the view of bringing the method before the Society. He subsequently found that this work was being done by Dr. Flögel, of Holstein, who, there appeared no reason to doubt, was not only a skilled and competent observer, but that he possessed every kind of appliance for making careful observations. Having ascertained this, the next thing was to obtain specimens of actual sections of diatoms, without which it was, of course, not possible to form any satisfactory judgment on the matter. He was fortunate in persuading Dr. Schröder, now resident in London, to write to Dr. Flögel upon the subject, and in the result they had received a very elaborate paper, accompanied by a dozen slides and a number of photographs and drawings in illustration. A careful examination of the slides showed that Dr. Flögel was thoroughly familiar with the finest processes of mounting, and with all that had been done by Möller. One of the slides was exhibited in the room under a [illegible]in. objective by Mr. Powell. It was a section of *[illegible]*, and the excellence of the specimen gave rise to the impression that something even more difficult than this could be accomplished. Amongst the other specimens sent were some very clean cut sections, giving an exceptionally clear image. It was stated by Dr. Flögel that as many as 174 transverse sections had been made of one diatom, all of which could be plainly identified as belonging to the same diatom Mr. Mayall said that he could not pledge himself as to the correctness or otherwise of the theory set up by the author of the paper, as the subject was not one which he had made his own, although he had taken some pains to translate the paper for publication in the *Journal* of the Society.

Mr. Mayall then read an abstract of the paper to the meeting, and the subject was discussed by Mr. Curties, Mr. Crisp, and other Fellows.

The Chairman, in proposing a vote of thanks to Dr. Flögel for his paper, said that he was sure the Society would feel doubly indebted to Mr. Mayall for the exertions which he had made to procure the paper, and also for the trouble he had taken in the matter of its translation.

SCIENTIFIC NEWS.

THE death is announced of Mr. C. W. Merrifield, F.R.S., at Brighton, last week. The deceased gentleman was well known as an active member of the Institute of Naval Architects (he was one of the honorary associates), and as an authority on wave-motion, the seagoing qualities of ships, and the resistance of air to projectiles. He was born in 1827, and was elected a Fellow of the Royal Society 20 years ago.

In an interesting lecture on the Eskimos, delivered by Dr. Rae at the London Institution last week, the lecturer expressed the belief that they were originally an Asiatic race, who crossed from Siberia by Behring's Straits. They speak, with slight dialectical variation, one language from Labrador to Alaska; are physically very strong; have an unbounded love for their children, and are intelligent and faithful. The tallest male measured by Dr. Simpson near Behring's Straits was 5ft. 10½in., and the shortest 5ft. 1in.; the heaviest weighed 195lb., the lightest 125lb. The eyes have a fold of skin across the inner angle, giving the countenance a cast which is all but perfectly Chinese. An Eskimo's meal is often as much as 8lb. of seal or 12lb. of fish, while the clothing is made almost wholly of the skin of the reindeer. The dwellings consist of stone and mud kraals, wooden huts, and snow houses, according to locality, and are generally very snug and comfortable.

It is stated that Dr. N. de Konkoly, of the observatory, O-Gyalla, Hungary, will succeed M. Houzeau as director of the Brussels Observatory.

From an analysis of a sample of water taken from the famous well at Mecca, known as Hagar's or the Zemzem well, Mr. C. W. Heaton gives the following rather extraordinary figures:—Total solid matter per gallon, 464·4 grains; chlorine, 75·5 grains; nitrogen (as nitrates), 13·75 grains; nitrogen (as nitrites ·09 grain; ammonia ·358 grain. No albuminoid ammonia was found, probably due, says Mr. Heaton, to the completion of the putrefactive process. The fearful nature of this "holy water," which is used as a medicine, can be judged by comparing the following figures, which are those obtained from an analysis of London water supplied by the Thames companies: Total solid matter per gallon, 18 grains; chlorine, 1·5 grain; nitrogen (as nitrates), ·18 grain; ammonia, ·001 grain; albuminoid ammonia, ·004 grain.

In connection with the Turin Exhibition the Italian Government have offered a prize of £400 (10,000 lire) to any one who shall perfect the most useful and practical system of generating and transmitting electrical energy.

An experiment with the electric light is being tried on one of the trains of the Metropolitan District Railway. A Siemens dynamo and a Willans engine are placed in a van, steam being raised in a small boiler also placed in the van. Should this tentative trial prove satisfactory, the Willans engine and the dynamo will be placed on the locomotive, the boiler of which will supply the steam. The train being a short one, there are only 28 Swan 20-candle lamps in the carriages, but 22 or more are placed in the van, the object being to ascertain the cost of working 50 lamps, the number required for one of the ordinary trains.

Mr. Barnett has had his system of distribution at work in the offices of Mr. Spagnoletti at Paddington Station. He has invented an improved accumulator, which is stated to be superior to anything known, for the loss of current in ordinary work is "less than 10 per cent." Each battery for use in train lighting measures 22in. by 7in. by 7½in.; it is provided with footplates, by which means the connections are made when the battery is simply put into position. One battery will, it is stated, maintain a 12-candle Swan lamp from 10 to 20 hours—rather a wide margin. The system has been under trial at Paddington for three months, and is said to have worked satisfactorily.

There is a deficit of about £6,000 in the finances of the late Vienna Electrical Exhibition.

Mr. Baird, of the U.S. Fish Commissioners' steamer, *Albatross*, gives an account of the success attending his endeavours to use an incandescend a lamp at a depth of a hundred fathoms. The pressure is so great at that depth that several failures followed the earlier attempts, then the Edison Company made a lamp in which the fine platinum wires were soldered to pieces of No. 16 copper in a glass cavity which was then filled in with resin. These copper wires were coiled into spirals and soldered to the heavy wires in the cable, and the joint was covered with two coats of "gullock" and tape, and finally with guttapercha, which was seared over with a warm iron. Instead of a cut out plug in the deep sea circuit, another lamp is put in, and that being kept on board indicates by its condition that the the lamp at the bottom is burning all right.

Capt. Poly has, it is stated, introduced a new bridge signal and helm indicator, with the view of preventing collisions at sea. The indicator exhibits red or green flares of from ten to fifteen seconds duration, according to the position of the helm.

According to M. Mering, of Strasburg, chlorate of potash passes through the organism without, in great part, undergoing any change. Methæmoglobin is formed when blood and chlorate of potash are mixed, and a part of the latter is reduced.

Prof. McIntosh, of St. Andrews, will make a series of periodical excursions to the trawling grounds on the East Coast of Scotland, between Aberdeen and Berwick, during the next six months, for the purpose of making certain investigations into the trawling grounds, their inhabitants and surroundings, required by the Trawling Commissioners.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, [illegible] Covent-garden, W.C.

All Cheques and Post-Office Orders to be made payable to J. Passmore Edwards.

In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects. For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—Montaigne's Essays.

FRACASTORIUS SATURN COMET PONS

[illegible]

Pons been made? If any have, it would be interesting to have them published. On the 30th I saw it; I thought it about 3½° in length. The night was misty, and the comet must have been very bright to have been seen so well. I estimated in an opera-glass the total light of the head to equal ζ Cygni, but it was perhaps brighter.

G. Maitland Baird Gemmill.

SATURN.

[22219.] Dr. Kitchener used some such powers as W. C. Gurley mentions (letter 22190), and he comments:—"Such powers are very useful for showing the uselessness of any such enormous magnifiers." Allow me to ask whether Mr. Gurley is sure of the odd 4 diameters in his highest power, and if he will tell us how to distinguish or measure the difference betwixt 1,300 diameters and 1,304? Is not the letter a hoax? The drawing by Trouvelot is well known to be the utmost the Washington telescope would show, yet here is a 6¼in. equalling it in every respect, and I should say surpassing it in some.

Edwin Holmes.

A PHOTOGRAPH OF COMET PONS-BROOKS.

[22220.]—We beg to inform you that on December 24th we succeeded in photographing comet Pons-Brooks. The exposure was 53 minutes. The comet comes out on the plate as a circular haze, without any trace of a tail. The star magnitude is about equal to γ (gamma) Cygni. The comet at the time was near ε (Epsilon) Cygni, and was inferior to that star according to an eye estimate. On the plate, however, the brightness is very considerably greater. A heavy dew was falling, and the lenses were badly covered.

T. E. Espin.

The Observatory of the Liverpool Astronomical Society, West Kirby, Jan. 1, 1884.

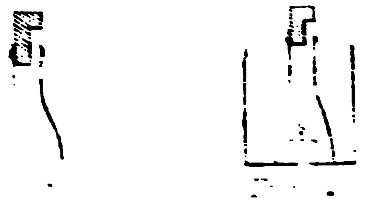
AFTER-GLOW.

[22221.]—Some 22 or 23 years ago, whilst in Cornwall, I observed some beautiful colour effects in the clouds at sunrise during several successive spring mornings. The clouds appeared to form several lines of diversely-tinted strata—some red, some orange, some golden yellow, some purple; whilst between these streaks of blue sky could be seen which seemed to merge into a decided green tint where they touched the golden or orange clouds. I have not seen any equal to those since that date.

Galvanoplast.

A CHEAP LANTERN FOR GELATINE PLATES.

[22222.]—The cost of this lantern is nothing at all, for every amateur who practises photography has the materials required—viz., a green glass bottle and a jam-pot of white earthenware large enough to admit of the bottle being placed within it. Next cut off the bottom half of the bottle, by first holding the bottle over a candle, and then plunging it into cold water; this will establish a crack which is led round the bottle with a red-hot poker, thus cutting it into two parts; then place the upper portion, with the neck into the jam-pot, neck upwards, and observe how far the neck appears above the jam-pot; this portion blacken with Brunswick or Japan black. Then take the cork belonging to the bottle and cut a piece out of it, like Fig. 1; the



cork being placed so that the heat and smoke can escape.

[illegible]

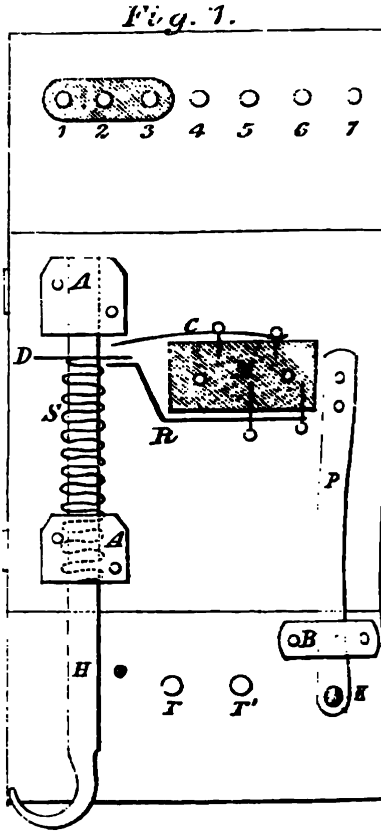
[illegible]

NEW TELEPHONE SWITCH-BOARD AND TRANSMITTER.

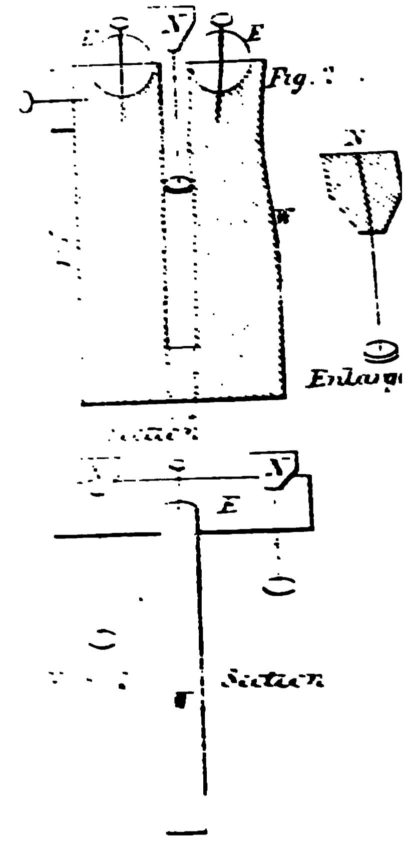
[illegible]

patent for the arrangement could only be val
for a particular combination of parts, as rec
decided in respect to the Bell telephone, and a
combination of parts is susceptible of so
variations that a patent would be practically

Fig. 1.



less, I send you for publication a sketch of
arrangements, with such a full description as
enable any amateur to make them. The sketch
switch-board, as I send it, is the actual s



though it will probably be reduced by [illegible] graver. The parts are slightly in excess [illegible] as I have drawn them by [illegible] round the pieces. Fig. 2 is [illegible] but the dimensions are given in the [illegible]

Switch-Board.—Take a piece of mahogany 8 by 4 by 1, plane it up and varnish it. On the top, at a distance of ¾ of an inch from the top, fix seven terminals ½in. apart; these are numbered in the sketch 1, 2, 3, 4, 5, 6, 7, and are for the following connections: 1 2 3 are connected together by the brass plate as shown; 1 is connected to the return line or earth wire; 2 to the zinc pole of the battery; 3 and 4 to the bell wires; 5 to the carbon pole of the first cell; 6 to the carbon pole of the last cell; and 7 to the line wire. P is a strip of brass with the knob K at the lower end; it is secured by two screws at the upper end, and is then bent upwards so as to press against the bridge B, which is a strip of brass secured by the screws at each end, each of which screws passes through a piece of brass tube which keeps the plate B about ¼in. from the board. The piece P is connected by a wire underneath the board (all the connections are made underneath), with the terminal screw 7. Underthe knob K is a screw with a flattened head, which isconnected with terminal screw 6: this constitutes the ringing key. H is a piece of ¼in. brass rod with the hook at the bottom, and the round brass disc D about ⅞in. in diameter, soldered about ½in. from the upper end; this rod works freely up and down through the two pieces of angle brass A A. S is a spiral spring of brass wire which, when the telephone is taken off the hook, causes this rod to rise, and the disc D then presses the thin piece of hammer-hardened brass C against the upper angle brass A. In order to insure a good contact this strip of brass C is slightly canted at the end so as to give two rubbing contacts, one against the disc D and the other against the upper angle brass A. When the telephone is on the hook the disc D rests on the piece of brass R, which acts as a contact and as a stop. The total play allowed to D is about $\frac{3}{16}$in.; the lower angle brass A is connected with the bridge B; the piece of brass R is connected with the terminal 4; and the thin piece of brass C with the upper hinge. T and T¹ are brass screws to which the flexible wires of the telephone receiver are attached; T is connected with terminal 5, and T¹ with the lower hinge. M is merely a piece of mahogany to which the pieces C and R are attached.

We now require a square frame of ¼in. mahogany, 4in. square in outside measurement, and 1⅜in. deep; apertures are cut in the bottom side of this to allow the rod H and the ringing key P to move freely. This case is attached to the hinges marked, and with a face piece of pine about ⅛in. thick, boxes up the whole of the apparatus, leaving on y 2in. of the board at the top, and the same at the bottom uncovered; a small plate of brass is screwed to this box opposite to the hinges, and one screw into the switch-board prevents the box from being opened.

To the centre of this piece of pine the microphone transmitter shown in Fig. 2 is attached.

This microphone is thus constructed:—Take a piece of pine about $\frac{5}{16}$in. thick, ⅞in. wide, and 1⅜in. long, remove part of one edge so as to leave a projection as shown, and about $\frac{1}{16}$in. deep and $\frac{3}{16}$in. square, by which it is attached to the centre of the pine face of the box; put a sawcut down through it to within about ¼in. from the bottom. Take two pieces of ¼in. carbon rod 1¼in. long, E E, and cut a recess in the middle of each half-way through, and a little more than $\frac{3}{16}$in. wide; drill a small hole in the middle of each recess; bend a narrow piece of very thin sheet brass over the top of each arm or leg of the piece of pine; solder a wire to each piece of brass, and then secure the carbons by screws to the piece of pine as shown in E E. These pieces of carbon should be parallel, level, and a little less than ⅛in. apart; the wire from one carbon is taken to the top hinge, and from the other to the bottom hinge. I find that some of the carbon rods now sold have a coating of glaze, which is almost a non-conductor. I therefore always remove this with emery paper. This piece of pine with the carbons attached is now screwed to the centre of the pine cover of the box, and care must be taken that it does not touch anywhere else, and is not touched by anything. The microphone is completed by making two small conical pieces of carbon as shown, N, with a small hole in the centre of each; a lucifer match or other small piece of light wood is then filed or sand-papered down until it is as small as a knitting-needle, and will just go into the holes in the carbon cones. In one carbon cone I put a piece of this wood about ¼in. long, and in the other carbon cone a piece about ⅜in. long, and round the bottom of each of these pieces of wood I put a small ring of lead wire, they are then put in position on the carbon rods, and appear as shown in Fig. 2, end view, where E is one of the horizontal pieces of carbon rod, and N N the carbon cones: they should oscillate freely. I cut these carbon cones from $\frac{5}{16}$ rod.

I have long been of opinion that the hard carbon microphone works by make-and-break as completely as the Morse tapping key, and that the suggestions as to minute arcs, &c., were unwarranted by facts. I have also satisfied myself that the Bell telephone or my clear-speaking telephone, and certainly the latter, will reproduce human speech when actuated by an intermittent current, or current of sudden impulses, and that the idea that what Bell describes as an undulatory current is essential to the reproduction of human speech, is altogether untenable. I wanted to get rid of the spark so often seen in the microphone when a strong battery is used, and which has been the subject of so much learned writing. I believed that this spark was merely due to the well known "extra current," and I determined to try the plan that has for very many years been in use for getting rid of the spark at the contacts of electric clocks and other apparatus. I therefore made a resistance coil of 54ft. or 55ft. of No. 36 B.W.G. German-silver silk-covered wire, which gives a resistance of a little more than 100 ohms. I connected the ends of this resistance coil to the two hinges; no spark is perceptible, and the articulation with my clear-speaking telephone as a receiver, is as nearly perfect as anything I have met with in the telephone line. This coil is fastened inside the case above the hinges by a small screw.

I do not advise the use of induction coils with transmitters, and the above-described switch-board must be altered and made more complicated if they are used; but the arrangement is suited for any good receiver. In connecting up two stations, it will, of course, be remembered that the battery connections at one station must be reversed; that is, the carbon wire attached where I have directed the zinc wire to be attached, and the zinc wire attached where I have directed the carbon.

For battery power, I find that the battery required to ring a fairly good, ordinary bell works this arrangement well; thus if two Leclanché cells ring the ordinary bell nicely, then put one Leclanché cell at each end of the line in circuit with the telephone; if three Leclanché cells are required to ring the bell, then put two cells at one end of the line, and one cell at the other end in circuit with the telephone.

I have omitted to mention that outside the pine cover to which the microphone transmitter is fixed, I screw by its four corners a piece of cork 3½in. square and about ¼in. thick, with a ⅝in. hole punched out of the centre. This damps all the sound vibrations, except where they are alone required, that is, in the centre where the microphone is attached, and is a great improvement.

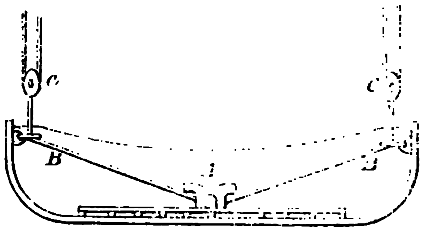
A Royal Academician, on seeing this apparatus, might perhaps declare that it was "entirely devoid of all artistic merit." An ornamental and costly affair it has not been my object to produce: simplicity and efficiency I have alone had in view, and I believe that any one, amateur or professional, who may try this arrangement will say that I have fully succeeded; whilst as to cost, this switch-board and transmitter can be made and sold with a fair trade profit for about fifteen shillings.

H. B. T. Strangways.

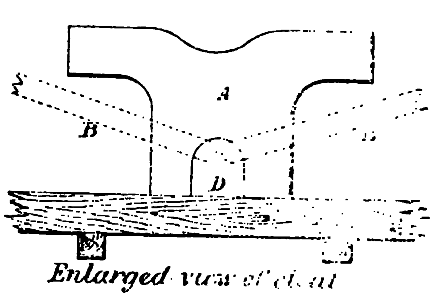
5, Pump-court, Temple, E.C.
Jan. 1st, 1884.

BOAT-DETACHING CONTRIVANCE.

[22224.]—THE object of the boat-detaching contrivance about to be described is to provide a simpler and less expensive one than any now in use—one which is next to impossible to put out of order, not liable to be bent, rusted, frozen, or choked with dirt; it will even bear to be jumped on by a heavy seaman in his boots. It is certainly not self-acting, but the practised eye of an average seaman can be depended on to let go a rope at the right time.



Half section of boat



Enlarged view of cleat

It simply consists of a cleat A bolted in the middle of the boat to the kelson or bottom board in which a mast may be stepped. The cleat is made double legged where it is bolted down to the kelson, a hole D being made between the two legs, and is shown in larger size under the section of the boat. The tail ropes B B spliced or otherwise joined to the eyes of the blocks C C, through which the falls from the davits are rove, are continued through the rings of the ring bolts (to which the blocks are ordinarily hooked) and from thence brought, both of them, to the same side of the hole in the cleat, through which they are both passed. The two ropes are then slightly twisted round each other, and in their twisted state are passed sufficiently round the arms of the cleat to hold the weight of the boat. The free ends of the two twisted ropes, made as short as possible, are to be tied together with as weak a piece of twine as will hold them twisted, and may be hooked by the twine to any convenient place so as to keep the ropes constantly belayed. In this twisted state it will be easily seen that one end of the rope cannot be drawn out without the other.

When the boat is ready lowered for casting off, the sailor first slips the ends of the rope off the hook and holds them in his hand, either cutting the twine or not, it does not matter; at the proper moment he lets go the ends of the ropes, having, as every sailor knows how, just left enough turns of the ropes round the cleat to hold in his hand the weight of the boat. The twisted ropes run out at the same time as the boat falls instantly with the sea; if there is only a pull on one end of the boat, still both ropes run out and are freed at the same time. Either a few slats can be nailed up and down under the seats to confine the escaping ends of the ropes, or two short spouts may be made for the purpose.

The secret of the efficiency of the contrivance consists in just twisting the two ropes round each other sufficiently to make the one pull the other out with it, and at the same time to freely untwist themselves so as to offer the slightest hindrance to their separation.

31st Dec., 1883. **W. Byers.**

KEY CHARACTERISTICS IN MUSIC.

[22225.]—MR. TEMPLETON seems to be wandering away first on one side issue, then on another. I instanced the voice harmonium as a proof that there is no such thing as key characteristics when an instrument is in just intonation. Mr. Templeton demurred to that, because it seems he hurt his finger by a falling window, and, therefore, the voice harmonium "does not give perfect intonation" (p. 345). All I can say is, it ought to, and if it does not, it must be the fault of the tuner or the conjuring of the player. Mr. T., however, "knows" that when the reeds are set on end in the voice harmonium, the high-pitched ones "give no sound at all." Well, if that be so, there is an end to my contention, for, of course, it is impossible to say whether an instrument is in just intonation if it gives no sound at all, and also equally impossible to distinguish key characteristics—so, friend, I must be partly right after all. But allow me to hint just a doubt as to the soundness of Mr. T.'s knowledge. I suppose these speechless reeds were made to speak, and that they are willing to speak; why, then, don't they speak? Not because they happen to be placed on end, or because they are in the voice harmonium, or because they are tuned in true fifths—oh dear no! It is simply because the "master" was away, and Mr. T. does not know how to make them speak. Let him call in a reed voicer, and his reeds, high pitched or any other pitch, will speak fast enough. **N. E. Child.**

TRICYCLES.

[22226.]—IN fairness to my veracity, I hope our indulgent Editor will allow me to say a word or two in reply to our correspondent "Ex." (letter 22206), who seems to think that I complain without sufficient knowledge. I hope he will not be offended when I say that my remarks are based upon actual observation, and knowledge derived from having spent most of my life among machinery of all kinds, and a few of those years with an engineer's firm of very high repute. I have made out some hundreds of invoices of repairs, but I was never expected to condense them quite so much as "Ex." seems to do.

I am sorry that he seems to have even a lower estimation of some firms' commercial morality than I stated: but his remark about riders having no mechanical knowledge of what they buy would imply that their money is taken, and just any sort of machine work palmed on to them.

He says, with respect to cast iron being used, "good makers do not." I am afraid I could instance a good many parts about machines turned out by firms considered very good that are made of that material, and I have seen them broken and repaired, and in one or two instances I have had to get my own sliderest and tools at work.

I am speaking of machines made specially to order, and for which there was no haggling about base of the slide-rest, which would fit on to a set-square running between the shears on the top, or else fitting the head of bolt used for fixing hand-rest, and then when the work to be done was not longer than the traverse of the top slide, the rest might be shifted off the saddle on to top of bed, and thus save front slide from all unnecessary wear.

What would be the best way of working the nut? There would be very little room for the two halves to work upwards and downwards in. Is not a long half-nut used by some of the best makers now, instead of having the two halves to grasp the whole of the screw? **Fredk. Carre.**

COMPOUND ENGINES.

[22233.]—"ENGINEER, DEWSBURY," having candidly admitted that his engine could not work under the conditions he laid down in his first letter, and that I was correct in stating that there would be great danger of the high-pressure cylinder head giving way under the enormous pressure it would be exposed to from the compressed steam, your correspondent, "M. H. R.'s" suggestion, that a receiver be placed betwixt the two cylinders of ten times the capacity of the high pressure has assisted "Engineer" out of his dilemma to a certain extent. I should esteem it a great kindness if he would show what amount of power he would get out of his engine working under the amended conditions. "Engineer" states that my calculations are not correct as to the amount of power he would get out of his low-pressure cylinder. I stated that with 8½lb. average effective pressure he would get 37 h.p. I refer him to his formula as he gave it in his first letter, $\frac{14\cdot79 \times 360 \times 400}{33000} = 53\cdot8$ horse. If "Engineer" substitutes 8·5lb., which is the correct pressure, he will see that my figures are right. "Engineer" has also discovered that I am in error in stating the initial pressure in low pressure at 14·5lb.; he says it should be 14·4lb., an error of one-tenth of a lb. This is splitting hairs with a vengeance.

Dewsbury. **Engineer No. 2.**

CONCERNING LOCOMOTIVES.

[22234.]—MR. GREY, page 386, tells us that there seems much uncertainty as to the actual horse-power of locomotive engines, and confirms his perfectly correct statement by informing us that "persons likely to know" cannot give him the information. Here we have in a nut-shell the root of the question. It is this *uncertainty* with regard to horse-power which caused Pambour to look out for a better standard, and for this reason locomotive engineers express the power of their engines in *tractive force*, about which there is no uncertainty. *Theoretically*, the horse-power can be worked out in the way given by Mr. Grey; but, *practically*, the results will be useless, as the before-mentioned "*uncertainty*" exists. In short, it is to be regretted that the term *horse-power* was ever used with regard to locomotive engines.

Mr. Grey still appears to hold the opinion that the work an engine will do can be calculated from the dimensions; here I distinctly disagree with him. There are very many useful rules for calculating certain dimensions of parts, all of which are the result of actual experiment. A designer knows by experience the results of working of a certain class of engine. He considers that by making certain changes in design his next engine will give improved results. When the new engine is finished it is tested, and the nearer the practical working comes up to the expectations of the designer, the more it is in his favour. The idea that any fixed rule exists by which an engine can be designed and its actual working discovered, is, indeed, absurd: if only such a rule could be found we should require no more locomotive superintendents and designers, but only a person who could understand plain figures.

At the present moment many railway companies are making experiments with various designs of new engines or new parts, and to prove that experiments are necessary to success I can only say that, out of every twenty ideas (which look well on paper) when tried on the rails, not more than one proves successful. This opinion is the result of a long practical experience in locomotive engineering.

Manchester. **Historian, M.I.M.E.**

LIGHT AND HEAT.

[22235.]—IT has been stated that science knows nothing of the restorative energies of nature. However true this may be to the astronomer, or even the natural philosopher—although as students of the infinite, they might be credited with more exalted opinions of the powers of the human mind,—the examination of any portion of terrestrial matter reveals to the chemist there is concealed within it a form of energy whose power of expansion seems almost boundless. The various chemical compounds which on being exposed to heat or friction explode with varying rapidity and force, are examples of its action that cannot well be overlooked. And, although there are compounds so stable as to resist either for their decomposition, yet the existence of this expansive force within them is as undoubted as if it betrayed its presence by combustion or explosion. When the chemist endeavours to overcome the cohesion of these intractable substances, he accomplishes it by the addition of other elements of matter. Thus the action of aqua-regia on gold enables him to dissolve this most intractable substance, and a further addition of ammonia throws down a precipitate so unstable that the detonation of only a few grains is attended with tremendous energy. Now, he knows that the addition of nitrogen has not added to the amount of expansive force; there is the same quantity weight for weight in dynamite as in clay, and no more; but the power of cohesion to maintain the state of condensation in the dynamite is now nearly balanced by the presence of the condensed nitrogen, and the compound must be handled with caution. Precisely the same conditions are observed in all terrestrial substances. If a diamond is under examination he knows this piece of carbon, the hardest and most transparent of all solids, has nevertheless a hidden energy that would, if unopposed, expand it indefinitely. As the result of his analysis the chemist declares the existence in all terrestrial matter of two forms of energy, namely, a gravitating and condensing force, and a force of unlimited expansion; and, that in unvarying proportion, both are present in matter in all conditions, either solid, liquid, or gaseous. It remains for the astronomer to determine whether they exist in space dissociated from matter or not. Attraction of gravitation and the luminiferous ether pervade the universe; the question is whether matter in any form or condition is present with them.

An Inquiry into the Causes of Light and Heat.—The question "What is Light?" has been satisfactorily solved with the conviction that it must consist in the undulatory motion of an infinitely elastic substance pervading space. This was long considered the best explanation of the known phenomena of light, until it was finally proved a fact by Fresnel's interference experiment. The phenomena of polarisation demonstrate that the vibrations of light are at right angles to the direction of the rays, by showing that whereas in a ray of ordinary light the vibrations are transversal in all directions to the line of propagation; they are, when completely polarised, vibrating in one direction only. The phenomena attending refraction have also shown, by the difference in the rapidity of propagation of light in various refracting media, as well as the amount of deflection its rays suffer in their passage through them, that the density of the luminiferous ether varies in different substances; whilst the phenomenon of double refraction, as shown by various crystallised substances, notably Iceland spar, demonstrates this density to vary in different directions in the same substance. Thus the velocity of light in air as compared with water is as 4 : 3; whilst in glass it is as 3 : 2. Light is, therefore, propagated more slowly through strongly refracting than feebly refracting media, and formulates the law that the index of refraction between one medium and another is equal to the relation that the rapidity of propagation in the one medium bears to its rapidity in the other. The dispersion of light illustrates the remarkable fact that the luminiferous ether is not a simple but a compound substance, each component giving rays of different colours, different wave lengths, and different refrangibilities; so that in a colour dispersing medium the various kinds of light are propagated with different velocities and consequently differently refracted.

Having thus acquired a knowledge of the true nature of the luminiferous ether, that it is a substance infinitely expansible and elastic, pervading the entire universe, and contained in varying density by all natural substances, there remains for examination the cause of the vibrations called light.

The burning of magnesium in oxygen gives one of the most brilliant lights known, the product of combustion being the oxide of the metal. Now, the problem to be solved is the cause of the intense light. Before the solid metal can combine with the gas, it must itself assume the gaseous form. To enable it to do this it must be strongly heated to overcome the force of cohesion of its particles. This being effected, chemical affinity comes into play. The metal assumes the gaseous form, combines with the surrounding oxygen, and condenses into the solid white powder forming the product of the combustion. Observe the changes in the density of the materials and contained ether here described. First the solid metal expands into the gaseous form. This expansion is suddenly checked, and then, during or after chemical combination, as suddenly condenses into the solid form again. It is this sudden check to the expansion of the metal, followed by the condensation of both the chemically combined substances which produce the brilliant light. A powerful vibratory motion is effected in the condensing ether by the sudden stoppage of the expansion and the instant condensation, the intensity of the vibration and the consequent brilliancy of the light being in proportion to the extent and velocity of the condensation.

Thomas Ayers.

(*To be concluded.*)

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[52132.]—**Excellent Yeast.**—I cannot discover in what particular "E. R. D." failed. If there does not come a scum on the liquid in making it, the yeast won't do. Be particular to have the flour dry. Perhaps here you failed. No matter how strong, it won't work well with damp flour. Try again with small quantities. There is no doubt the yeast is worth a few experiments.—BARLEY BREAD.

[52181.]—**Balance (?) Gear of Omnicycle.**—I find "W. H. S. W." is perfectly correct—the omnicycle has no balance-gear. It is a clutch driver. What is the advantage of the inside wheel only driving? Would some of your single-drivers tell us which is the easiest side to turn—viz., when the driving-wheel is on the inside or outside edge?—JOHN ALEX. OLLARD, Enfield.

[52205.]—**Chloroform Balsam.**—Care must be taken to get the chloroform absolutely pure; otherwise, the water in it will appear after a time, and cause spots. The same result can be obtained by breathing on the cover-glass or balsam just before mounting. I have mounted over 500 objects with chloroform balsam, and so long as the pure was obtained and used, the result was good. On one occasion, I used some slightly methylated, and the slides were spoilt. I understand that carbonate of potash will absorb all the water from the chloroform, thus leaving it absolute. In most cases, I think the balsam only hardened round the edges, thus leaving the object in a cell mounted in liquid balsam. I have slides mounted several years ago, where the chloroform balsam is still liquid in the centre, and there are no spots, &c.—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[52302.]—**The Cheapest Food.**—My reply to the remarks of "S. R.," on page 372, need not take up much space. This correspondent has said nothing which, in my opinion, shakes the simple statement made regarding Dr. Nichol's Food of Health and the American Breakfast Cereals, which are wholesome, delicious, and (on the whole under the circumstances) cheap. There are several points in "S. R.'s" communication on which I should like to touch, but will refrain, as the cheap food controversy raised by my friend appears to have concluded.—ARTHUR MEE.

[52307.]—**Gas Engine.**—Many thanks to "S. M." for his answer to my query. I will try and describe the faults of my engine. First, the engine is supposed to fire every revolution, but it don't; next, the charge is fired by the piston driving a small portion of the charge through a small hole, which is covered by a piece of wire-gauze. The said hole has a set-screw in it to regulate the quantity of gas that passes through into the hollow chamber in the valve, which is worked by an eccentric rod. The gas in the chamber coming in contact with the side-light, it is carried into the cylinder as a bead of fire, but with my engine it very often goes out, causing the charge to miss fire. There is not any air-pump, as in the Clerk engine, to wash out the products of combustion. Now, if I am not mistaken, after the explosion takes place it leaves the cylinder full of carbonic oxide, and not having a scavenger stroke the same as the Otto, the fresh charge of gas and air becomes mixed with the products of the last explosion, which I should think has a very detrimental effect to the proper combustion of the charge if it allows it to fire at all. I want to take away the present defective arrangement and put a slide in its place, so that it will have a scavenger stroke like the Otto, but I should like the slide to only have two faces, same as the Baron engine; I don't think they are so likely to cut up when they have two faces instead of four. If some reader will inform me the best way to start on the job I am certain I can carry it out successfully; I have a good lathe and plenty of tools at my command. I shall put a 4in. cogwheel on the shaft to drive the slide by a crank on an 8in. wheel, so that the slide will move once to every two revolutions of engine.—VOLT.

[52335.]—**Lacquering Brasswork.**—"Old Subscriber" will not be able to do good work in coppering bronzework without the battery. The best black bronzes are produced by the salts of platinum—the chloride, for instance. Dilute solution should be used, and the article should be heated. Chloride of antimony, with a little hydrochloric acid, will also give a black. Use the best [illegible] the stock, and colour to suit with dragon's blood, gamboge, [illegible], turmeric, red sandal and saffron. There should be [illegible] ready dissolved in [illegible], and by adding a little of one or the other, a mixture of two or more to the stock [illegible], you produce the [illegible]—[illegible]

[illegible]—**Test for Cane Sugar.**—Is there any difference between the crystals of cane and beet sugar? [illegible] an infallible test [illegible] depend on the [illegible] difference [illegible]

[illegible]—**Holtz Machine.**—[illegible] knowledge [illegible] Another [illegible] his statements [illegible]

[illegible]

[illegible] weight of water [illegible] more effect- [illegible] which they are [illegible] endeavour, then, to [illegible] much water as pos- [illegible] "M. Bourne" that the [illegible] are unsuitable, [illegible] as they pass [illegible] I would suggest that [illegible] similar to that shown in [illegible] which would not wholly [illegible] had the [illegible] until it

vertical centre at the bottom. The shrouds or sides should project about an eighth of an inch beyond the lips of the buckets. The water should be allowed to flow at first very gently, the quantity being increased in proportion to the speed with which the wheel revolves. This, of course, can be regulated to a nicety with a tap, and if these suggestions are carried out "Melbourne" need not waste the drop of water ineffectively.—WESTLAND.

[illegible]—**Watch License.**—An inquiry addressed to the Inland Revenue Office, Somerset House would produce an authoritative answer to this query. It seems to me it turns on the meaning of the word "agent," because a tradesman might call himself the agent of the manufacturers, especially when, as is often the case, he holds his stock [illegible] the makers—that is, on sale or return.—[illegible]

[illegible]—**Discharge of Water.**—The question [illegible] pipe, with a head of 50ft.: [illegible] must be allowed for friction. From [illegible] taking the head divided by length of [illegible] the delivery would be about 10 gal- [illegible]—[illegible]

[illegible]—**Pump.**—[illegible] the information [illegible] if it were my case, [illegible] deep, and [illegible] with a [illegible] pipe to the well. You [illegible] as much as you wanted. [illegible] as fast as the inch pipe [illegible]

[illegible]—**Removing Varnish from Oak Panelling.**—[illegible] the scraper with hot [illegible] varnish for oak [illegible]—M. [illegible]

[illegible]—There is no reason why raised [illegible] be as applicable to the [illegible] "Patent Plate" [illegible] the bridge in renewing [illegible] the whole of the [illegible] itself might have [illegible]. For this reason it [illegible] mark the position of the bridge [illegible]

[illegible]—**Skin Disease.**—"Mechanic" is [illegible] it appears in any part of [illegible] twice a day [illegible] at breakfast [illegible] globules of [illegible] globules of Thyra—[illegible]

[illegible]—**Siemens Dynamo.**—[illegible] the arrangement [illegible] diagram, and in the one I [illegible] the principle clear, not

[illegible] actual arrangement. It [illegible] drum armature of 8 divisions, or 16 [illegible] of wire, of which the wires in which the current ascends are numbered 1—15, odd numbers, and the descending currents 2—16, even numbers. Each section of the wire winds round and round the drum across the axis as nearly as space permits, so as to fill up the whole circumference; but in the diagram the ends only are considered, as though each section were a single turn of wire. It will be seen that an ascending and descending wire are everywhere side by side exposed to the same action, and therefore having opposite currents generated in them. These constitute the two opposing circuits presented to the collecting brushes and uniting as one, as in all this class of machines. The armature segments are equal in number to the sections of the wire—viz., 8 marked *a*, *b*–*h*, in a direction opposite to that of rotation, shown by the arrows in the field-magnet poles N. S. As shown, the most active sections are 1—16 and 8—9, while 2 [illegible] 3 will be the next to occupy the central line. Wire 1, in which the current ascends, is connected to armature section *a*, at which its current is given up to the brush; it is then continued to 2, which is one-eighth of the circle in advance of 16 against the rotation, so as to be carried forward by the motion. Wire 2 then descends, and crosses the drum at the further end diametrically, rising as 3. Here the wire has a branch to commutator segment *b*, and is also continued to the next descending portion 4, and so on, working round the cylinder, the end of 15 being joined to *h* on the commutator, and to 16 wire. Thus the whole wire forms one complete and endless circuit, divided at each pair of opposite segments, as they reach the brushes, into two opposed halves uniting as one in action externally. The easiest mode of winding is to construct a wood cylinder on the iron, of the thickness of the intended coils, dividing it into as many segments as there are of wire—16 in this case. These may be attached to the iron by one or two screws, or by clamps at the ends, and fitted with clasps to mount the whole in a winding machine. Now, if the two opposite segments are removed, we have a bobbin in which one of the coils can be wound securely; then an adjoining pair can be removed and the winding continued, and so on to completion.—SIGMA.

[52134.]—**Gout.**—Continual use of Physalis alkekengi is injurious to the system; on using it continually the rheumatism might settle itself in the bladder, and would be far more painful than at its present juncture. Take internally at breakfast in the drink, five globules of Bet. *a*, at dinner, in the drink, five globules of Per, at supper, in the drink, five globules of Thymus.—ETHEROPATHY.

[52443.]—**Overworked Brain.**—Takes Thymus 5 globules in drink at breakfast, Sedum 5 globules in drink at dinner, Antiventeux in drink at supper.—ETHEROPATHY.

[52462.]—**Bourdons.**—In reply to "S. O." (in the "E. M." of 14th Dec., 1883). I believe he should find no difficulty if he makes the pipes to a small scale, and voices them lightly—that is, not to make them "roarers." At present I am adding an octave of Bourdons, 16ft. tone, to a 5-stop organ which I built last winter. The scale I have adopted is [illegible] by 4¾ for C C C, and the pipes are diminished in regular proportions, one-eighth of an inch each way, till C C comes to 4¼ by 3¼. They are all square-mouthed, with lips cut low. The C C C and C C C sharp stand over their own wind; but the remaining pipes are conveyed off by tubes of 1in. diameter. All the pipes stand upon a surface of 3ft. by 2ft. The pedal soundboard is only 23in. by [illegible]in., 7in high. Distance of bellows is 2ft. With the weight of the bellows frame itself I find that the wind is almost sufficient to produce a round and full tone.—A. EVANS, Bank, Llandudno.

[52465.]—**Belt Working off Pulley.**—I do not wish to take upon me to answer for "R. R. N."—he doubtless will do that for himself; but I agree with him. And as "Firer" appears, from his letter, to have been practising and found that, contrary to mechanical rule, a belt will run down-hill rather than up, perhaps he will, for the benefit of our readers, show in what way he has tested the question, and how he has drawn his conclusions.—WM. HOSKEN.

[52474.]—**Strain on Jib Chain.**—From his questions on page 392 it seems that "Radnor" has but little knowledge of mechanics. He should attend lectures, or get a friend to put him in the way of reading on the subject. The two answers refer to a crane which is not exactly the "derrick." In the derrick crane there are two chains at or near the line A, the burden and the jib chain, and P is approximately the sum of the strains on the two chains. As the strain throughout the burden chain is W, the strain on the pit chain is P – W.—J. S. C.

[52474.]—**Strains on Jib Chain.**—In the case suggested by "Radnor," the strains will be, on the jib chains 7 tons, and on the jib a little over [illegible] tons. "Radnor" will see, from "J. S. C.'s" method, that he is wrong in supposing the leverage to be unaltered. He can check the above as follows:—Let him measure the length of jib chain, length of jib, and height of mast. Then let T represent jib chain, P the mast, J the jib, and W the weight on burden chain. Then the tension on the jib chain = $\frac{T}{P}$ W, and the compression of the jib = $\frac{J}{P}$ W. Of course, if the chain pass along T, and down the mast to the chain barrel, it relieves the tie-bar of an amount of tension equal to that in the chain—namely, W divided by the number of falls in the overhanging part of the chain. If the chain pass along the jib, the compression will be increased by an amount equal to the tension of the chain.—J. S. B.

[52483.]—**Neuralgia.**—Dr. [illegible] Mattei says, "Rub the top of the head and back of the neck, and ears, twice a day with the electric balm; take internally Thymus, Bet. [illegible], Vulv. [illegible] globules in drink at meals."—ETHEROPATHY.

[52489.]—**Rain Gauge.**—Would the plan I adopt help "M.M.I.Sc.S."? My gauge is by Negretti and Zambra; model similar to that described by "F. R. A. S." I use an old iron paint can as receiver, placing on it the funnel, keeping the tube part and measuring rod under cover, pre-

[illegible] for as [illegible] have that you [illegible] are creditor for it [illegible] must go to the [illegible] the surveyor of taxes [illegible] state: or [illegible] say—say [illegible] will give you all [illegible] to enable you to do all [illegible] at a distance [illegible] telling them what [illegible] they will be at home, and [illegible] most easily with the help [illegible] experience of the matter.—[illegible]

[illegible] **St. Petersburg Standard.**—[illegible] are [illegible] sold at so much per [illegible] in their thickness [illegible] boards at so much per [illegible] Petersburg Standard. This standard is [illegible] long, 11in. wide, and [illegible] a matter of figures to [illegible] into this standard. The [illegible] is 2 standards, 1 [illegible] representing 26½ pieces of [illegible] at [illegible] each = £15 19s. 2d. —[illegible]

[illegible] **St. Petersburg Standard.**—In [illegible] Jno. Wilson, a Petersburg standard [illegible] deals consists of 120 pieces, [illegible] and contains 1,980 superficial feet. Any quantity or variety of scantlings are [illegible] by reducing them to [illegible] feet and dividing by 1,980 for hundreds, [illegible] quarters of hundreds, and [illegible] single-standard deals; the [illegible] performed by doubling the [illegible] fractions are generally [illegible]. There are many short methods; but your space cannot be further occupied.

[illegible] deals, at £14.
[illegible] 5 0 0
[illegible] 4 10 0
[illegible] 1 7 0
[illegible] 0 1 2
£11 18 2

[illegible] pounds, if doubled, gives [illegible] pence or of a dozen in [illegible] Dublin.

[illegible] **Thermometer Screens.** The querist will [illegible] information on p. 267, No. 948, [illegible] but dimensions in the fifth line from the bottom should read dimensions. It is not in my power to give any more detail, or I would with pleasure. [illegible]

[illegible] **Bunsen** [illegible] should use dry coils. [illegible] good results from their [illegible] likely because the tube [illegible] and the temperature of [illegible] and lay boiler [illegible] non-conducting com[illegible] pavement.

[illegible] **Rapid Break.** To Mr. P. Ward. [illegible] that there are [illegible] tube which no [illegible] current, will make [illegible] general rule my rapid [illegible] states. I usually [illegible] plates [illegible] battery connected in [illegible] spark is not [illegible] are got with an [illegible] two forms of my rapid [illegible] Proceedings of the Royal [illegible] The first is auto[illegible] by hand. The [illegible] 6,000 currents [illegible] second. The theory [illegible] more uniform current [illegible] primary of an induction [illegible] the tube has not [illegible]

[illegible] **Eyepieces.** Tolles' eye[illegible] Mechanic, [illegible] No. 124 its [illegible] are detailed. [illegible] by filling [illegible] F.R.A.S." [illegible] of grinding, says [illegible] "I have [illegible] all possible [illegible] in the future, [illegible] the use of one eye [illegible]

[illegible] of the rubber [illegible] pretty and in [illegible] at the exact [illegible] P. Ward.

[illegible] **Clarionet Fingering.** [illegible] key [illegible] with B natural, and [illegible] does not produce good [illegible] shakes are impossible by the ordinary fingering. 2. Yes, you may proceed as you suggest, and in that case the above key will be used for the shake or trill on G natural with A natural, and A flat with B flat: but remember that if ever you should wish to play music which is written for the B flat clarionet (in company with other instruments), you will then have to transpose. If you had a C clarionet you could play with the piano without transposing, and the fingering would be much easier.—OLD BLOW HARD.

[52620.]—**Pyrotechny.**—The French and German works on pyrotechny are useless for teaching modern pyrotechnics. The English works named by "J. M. B." are the latest that have been published, and give one a fair idea of what has been done. All the new and most scientific principles of working are secrets—the work of years—and consequently will not be made public. If expense is no consideration, and "J. M. B." wishes to have all the latest information, and will advertise his address in "ours," I will try to help him. The spiral wreath of smoke from the balloon, or rather from the light this carries, is caused by the rotation of the case containing the magnesium light.—SCRUTATOR.

[52623.]—**Mural Decoration**—I am afraid our querist "E. C. N." will give himself an amount of trouble if he intends to prepare his walls for what he purposes to do. If he has the back numbers of the "E. M." and will refer to the number for October 26, p. 177, and read the article "Preparing Millboards," which I need not now repeat, it will give him some idea of the preparation required. In the first instance, however, a slight alteration from the directions there laid down will be needed. Having cleared the paper from the walls, he will have to thoroughly saturate the plaster with boiled linseed-oil, and when dry, repeat it until the plaster will absorb no more: when that is dry, he must follow the directions as laid down for "millboards,"—coating with ceruse and rubbing down with pumicestone;—unless the plaster surface is very hard and solid, his labour will not be of the least use. Instead of oils, "E. C. N." might paint in distemper; in that case, very little preparation would be necessary; perhaps, none.—GEO. H. LANCASTER.

[52628.]—**Thought Reading by Machinery.**—My opinion is, that it would be absolutely impossible to affix wires to the glass plates in Mr. Maskelyne's thought reader. Even the finest silver (which is the best conductor of electricity) would be seen at a glance.—P. WARD.

[52628.]—**Thought Reading by Machinery.** I do not know what is the nature of the mechanism between the operator and the automaton "Zoe," which enables the latter to write down the *numbers* in thought reading, or to draw the outline of a person's face, as exhibited by Messrs. Maskelyne and Cooke. Apart from any electrical or ocular signals, it struck me, when I saw the figure write down the number of a bank note, that as Mr. Maskelyn stood facing the audience, with the note held face upwards in his hand, at some little distance from his body, it would be very easy for a confederate concealed in the ceiling or upper part of the stage, provided with an opera-glass or telescope, to read for himself the number of the note, and so communicate it to the person who manipulates "Zoe." A suspicious element, I may remark, in the thought reading attributed to occult power, is that it is almost exclusively confined to numbers, easily communicated by signal. Mr. Maskelyne is quicker and does more than the mystery-mongers.—EYE-WITNESS.

[52625.]—**Field Glass.**—In reply to "Burgee's" first question, Chambers says, in the Galilean telescope the distance between the glasses is the difference of their focal lengths, and the magnification the ratio of their focal lengths.—ARTHUR MEL.

[52630.]—**Muffins.**—Mix a quartern of fine flour with a quart of warm milk and water, 2oz. of salt, and a wineglassful or so of yeast; then add another quartern of flour, mix well, let it rise for an hour. Knock it up, pull into pieces the shape of balls about enough for a muffin. Keep in a warm place, and when all the dough is worked up, flatten the balls into muffins and bake on tins. Turn when half done. Some dip into warm milk at this stage, which helps to impart a pale brown colour.—B. M.

[52631.]—**Dynamo Machine.**—A machine made double the size in every way would give four times the current, and would take four times the power to drive to work it to the full. I should, therefore, not advise A. Ritchie to double the size of the dynamo, unless he is prepared to use a small steam-engine or gas-engine to drive it. The dimensions given in the "E. M." will produce a dynamo which will tax a strong man to keep going for even a quarter of an hour. If made exactly twice the size, it will require a half horse-power engine to work it, and should be constructed without the standard and driving wheel, but should be driven by means of a belt and rigger. The size of the wire to be used will depend on the nature of the current required. If the external resistance is small, use No. 16 silk-covered for both magnets and armature. Put about 7lb. on each leg, and about 1lb. on the armature. If the external resistance is greater you may use No. 22, silk-covered, for both magnets and armature. Finer wire than this is not advisable. Remember also, although I recommend the old H-pattern armature for small hand dynamos as being very effective, very easy to make, and not easily put out of order: yet it is one of the worst kinds for large dynamos, which have to be worked for any length of time, since it soon gets very hot, and the insulation breaks down through that cause after 20 or 25 minutes' continuous work.—S. BOTTONE.

[52632.]—**Gas Stoves.**—The "Lux-Calor" is one of the best "stoves" (without flue) in the market; but I should advise Mr. Harcourt to look at Mr. Fletcher's latest, for cheerfulness and efficiency. It has a flue, and can be set on any hearth, or near an opening into the outer air, in two minutes, and can be either connected by flexible tube to the nearest gas-jet, or specially connected to a pipe under the floor, if desired. It is the only *economical* imitation of a fire which I have seen. I think the price is 21s. It is said to consume only 7ft. per hour.—P. WARD.

[52632.]—**Gas Stoves.**—The combustion of either coal or gas results in the production of water and carbonic acid, and no stove can possibly be healthy for a bedroom that does not possess an outlet to the external air. If Mr. Harcourt wants to rig up something of a temporary kind, he will find instructions in back numbers; or he should get a look at a calorigen. If I wanted anything of the kind I should fit up one of Fletcher's little gas-stoves in such a manner that it would heat air coming in from the outside, while the only connection with the atmosphere of the room would be where the air was drawn in to supply the burner. In other words, the chimney would pass outside, and might very well be a tube passing through the centre of a larger one by which the fresh air could be brought into the room.—NUN. DOR.

[52633.]—**Gas Flames.**—I believe there is economy in blending two gas flames, the rationale being that the result insures the exact amount of heat to render the carbon atoms in a state of highest incandescence before their conversion into carbonic acid. The Bunsen flame is the reverse of this.—P. WARD.

[52634.]—**Fluorescence.**—The most perfect manner Mr. Harcourt can adopt for the illustration of fluorescence is to use a good white light, rich in ultra-violet, and condense it from an ordinary lantern, having put in his condenser-cell, or other suitable place, some very deep violet glass (or about five or six thicknesses of ordinary blue glass will do). His stramonium should be an alcoholic solution. Among other materials he will find a decoction of madder in a solution (aqueous) of alum gives very good results; uranium glass, and many of the aniline colours in alcohol, especially fluorescine and eosine. The explanation of the phenomenon is, that rays of high refrangibility are rendered less so by the substances on which they impinge. Glass absorbs these highly refrangible rays to a great extent, so that quartz is used (which only absorbs a very few of them) for constructing the condensers where the greatest nicety is required. The electric discharge in a carbonic acid vacuum is very rich in these rays. Indeed, the natural phenomenon of aurora borealis is accompanied by rays of this kind.—P. WARD.

[52636.]—**Dihedral Angle.**—Is the angular space included between two planes which meet each other.—R. P. G.

[52636.]—**Dihedral Angle.**—The angle between two planes is called a dihedral angle, and is the angle between two lines drawn, one in each plane, perpendicular to the line of intersection of the planes from any point in that line.—C. W. B.

[52636.]—**Dihedral Angle.**—By this term is meant the angle made by two planes which intersect. In the usual method of representing planes by traces, this angle is not shown, but can be determined by a simple construction.—WM. JOHN GREY, Elswick Science School.

[52636.]—**Dihedral Angle.**—(Greek *dis* twice, and *hedra*, a side or face—foundation or base), having two sides or surfaces. Dihedron (another word), a figure with two sides or surfaces. I have never met with these words in any work on geometry that I have seen.—GEO. H. LANCASTER.

[52636.]—**Dihedral Angle**.—If "Coachmaker" had consulted any large dictionary, he would have found that dihedral (from the Greek *dis* twice, and *hedra* a seat) means having two sides or surfaces. Hence, dihedral angle is the angular space between two planes which meet each other.—EYE-WITNESS.

[52639.]—**Netting.**—"Hammock" cannot do better than procure a little work called "Netting," [illegible] and filed a flat on [illegible] cutting wheel on I [illegible] wheel on, making all [illegible] I find that it has [illegible] crank to move without [illegible] as tight a fit as possible for [illegible] key it from the front, as the [illegible] the axle too far up—about [illegible]in.—[illegible]

[illegible]—**Bristol and Exeter Single Express.**—Will any kind correspondent give particulars of this [illegible] Is it a broad gauge one? Are any of them [illegible] Any information will greatly oblige.—[illegible]

[illegible]—**G.N. Engines.**—Can any correspondent give particulars of 7[illegible] class, mixed engine, with outside [illegible] turned out last year? Is this a rebuild, or a new type?—H. N.

[52665.]—**Water Blower.**—Will some of my fellow-readers oblige with the working drawings of a water blower suitable for forge in a workshop? I have tried to make one according to what I heard about it; but it won't work. I don't get enough wind to keep the fire alight. I have a good water supply, and I am quite anxious to have one of the above-mentioned blowers at work. Perhaps some of our numerous readers will assist me.—YOUNG ENGINEER.

[52666.]—**Peep Show.**—Will some one kindly say how to fit up the inside of a peep show? I have bought one 3ft. 6in. long, 2ft. wide, and 2ft. 6in. high, and want to improve it. It has seven peep holes, and only shows a few photographs now.—SHOWMAN.

[52667.]—**Soil Pipes.**—Will Mr. Davies, or any other reader, explain how double bends are turned on long lengths of soil pipes?—YOUNG PLUMBER.

[52668.]—**L.B. & S.C. Engines.**—Can any reader give me dimensions of Craven's double-framed engines on this line (1) four coupled pass. engines—e g., 176, 1[illegible], 147, 148, &c. (2) Single engines, 194—200 class. Also Horsham, Norwood, &c. How many are there of these classes? Also, how many engines are there of Grosvenor class? This is the only one I know with 6ft. 9in. wheels? I do not mean 6ft. 6in. engines (325—359 class).—METEOR.

[52669.] **L. C. & D. Engines.**—I have recently come across dimensions of some 5ft. 3in. double-framed goods engines, one of which is named Constantine. Can any reader say how many of these there are, with their nos.? Also, what were the nos. of the Sharp Stewart's goods, a class of which one was in Exhibition of 1862?—METEOR.

[52670.] **Continuous Temperature.**—Can any one show me how to make an apparatus to keep one drachm of liquid at 100° Fahr. for three days?—HEAT.

[52671.] **Derbyshire Lime.**—Will Mr. Grey kindly give me a rough average analysis of the above?—L. B[illegible].

[52672.] **Cleaning Gaiters.**—I wear drab Canton (or jean) gaiters, which in wet weather get spotted. Will any reader kindly tell me how to clean them, and remove the spots or patches? I have tried pipeclay, but it is useless for the purpose.—CORPORAL.

[52673.] **Children Sleeping with Aged Persons.**—I shall be glad to know if it is really unhealthy for a child (or young person) to sleep with one much older than themselves? Also if it is at all unhealthy to sleep with any one who is in ill health, or delicate?—J[illegible].

[52674.] **Photo. Etching.**—Can any reader give me some good practical method of etching on copper plates by the aid of photography?—F. H.

[52675.] **Clayton's Gas-Engine.**—Will some reader kindly inform me how Clayton's gas engines explode the gas? When the piston is at the proper position, they are exploded with a red hot tube every second revolution. How is it the gas is not ignited when the crank is on the centre, or even before? Is it because the gas will not reach the hot part of tube until the proper amount of pressure is on, then that would be when crank is on the centre?—T. A.

[52676.] **Printing Paperhangings.**—How are the colours mixed for this process, and how are they applied?—X. L. C. R.

[52677.] **Casting Lead.**—What can I mix with lead to make it run easily? If antimony, in what proportion, and how to amalgamate?—X. L. C. R.

[52678.] **Printing Inks.**—How made? What [illegible] kindly confer this information?—X. L. C. R.

[52679.] **Bread Adulteration.**—To MR. A. H. ALLEN.—Is the addition of cooked potato considered an adulteration, and how best detected? Also, is there [illegible] amount of water, as I recently came across [illegible] containing [illegible] per cent., when dried to [illegible] the [illegible] bread [illegible] the moisture, in fact my [illegible] after the operation. The [illegible] Are any salts used [illegible]—AMATEUR.

[52680.] **Copper Sulphocyanide.**—To MR. A. H. ALLEN.—[illegible] a solution of ammonium sulphocyanide [illegible] sulphate of copper a [illegible] changing to white [illegible] any sulphide with [illegible] nitrate of silver or sulphate of [illegible] potassium sulphocyanide to [illegible] copper sulphate, I fail to get any [illegible] will oblige.—AMATEUR.

[52681.] **Legal.**—Can any one say if a claim on [illegible] is a legal one? He [illegible] Charles the Second's [illegible] to keep the Royal [illegible] Is it not a fact [illegible] (if ever legal), were [illegible] This particular [illegible] in private hands, and is [illegible] who pay it consider it [illegible] and that if [illegible] the payment would [illegible] on certain livings [illegible] scattered here and there—Norfolk being, I believe, specially burdened.—J. LUKIN.

[52682.]—**Electrical Problem.**—Two selenoids, one 12 centimetres long, 3cm. diameter, and 48 turns, the other 15cm. long, 2cm. diameter, and 81 turns, are suspended with axes in same straight line at a distance of 20 centimetres, and a current ·95 was sent through both in opposite directions. Find the force with which they repel one another in dynes. Prove that we get the greatest deflection of a galvanometer needle when the resistance of the galvanometer equals that of the rest of the circuit.—J. CROCKER.

[52683.]—**Bartolozzi.**—Could any of your readers give me the address of where the Bartolozzi Exhibition was held about a year ago in London? I sent a picture, and it has not been returned. I have lost the address.—X. Y. Z.

[52684.]—**Platinised Silver.**—I have a lot of plates to platinise for Smee's batteries, and would like to know how much bichloride of platinum to use to, say, each square foot of surface of silver plate, without being wasteful.—GULLIVER.

[52685.]—**Octave Coupler.**—Will either of your esteemed correspondents, "Organon" or G. Fryer, kindly give instructions for making and fitting an octave coupler to a harmonium?—W. IRELAND.

[52686.]—**File-Cutting Machine.**—Will any one kindly give description of best file-cutting machine—the latest and best one made? and oblige.—T. J. HAMILTON.

[52687.]—**Florida.**—Will some of the many readers of this widely-circulated paper kindly give me information about the climate and products, &c., of Florida?—it being my intention to emigrate there. Is the climate healthy? Which part is the healthiest and best in general for the emigrant—North, middle, or South? What county would you advise me to go to? I heard fever was prevalent. Is it so—is it of a bad kind? Are reptiles dangerous there? I have heard the orange is the most profitable culture in the State. Is it so, and what county is it carried on most extensively in? Is it a good climate for bees? Are they plenty? Can they be had at a reasonable price? What sort of hives are used—skeps or bar frames? It being my intention to carry on bee-farming, perhaps, after a time, if I find it profitable. What sort of houses are there?—wooden, I suppose. Would it be possible for me to get agencies for the sale of English goods out there? Can I get carpenters' tools at a reasonable price, or would it be cheaper for me to bring them out from this country (Ireland or England)? Also, what articles of furniture and clothes ought I bring out? What sort of clothes are worn? Would it be wise to carry out feather beds, mattresses, or bed clothing, also ware? If some of the readers of the "E. M." who have been out there, who have practical experience, or even those who have not been out there, but who have a knowledge of the State from friends out there, or otherwise, would give me general advice all about the country, the best place for emigrant to go, and whether it is a good place for a doctor, &c., they would oblige me much. I write on behalf of others as well as myself. Also advice about other States would oblige.—F.

[52688.] **Crank and Treadle.**—I shall be obliged if any one who may have tried or studied the matter will inform me how much throw to give double crank for 4½in. back gear general work, with dimensions of treadle crossbars, so as to get power without too much movement of foot. Also price of chain band used for same.—CHARLELOI.

[52689.] **Gold Washing.**—Can any one give an account of an electrical contrivance designed to facilitate the discovery and collection of particles of gold in a "washing" by magnetism? Such was mentioned in one of the newspapers within the last two or three months.—WASHER.

[52690.]—**Patent Armatures for Dynamo-Electric Machines.**—Will some of our readers who are versed in patent law kindly indicate how near amateur electricians can approach existing patents for armatures of dynamo-electric machines without infringing the patents? For example: Can an amateur make for his own use and amusement a dynamo machine with armature resembling the Gramme, the Maxim-Weston, the Pilsen-Joel, or any other form of patent armature, without rendering himself liable to legal proceedings? If not, what form of armature may he safely imitate?—GALVANOPLAST.

[52691.]—**Assaying Silver Alloys.**—Will Mr. Allen, or some other practical assayer, kindly assist me in determining the quantity of lead to be added to an alloy of silver and copper to remove every trace of the copper? How many grains of lead to the estimated grain of copper? Also please assist me in determining the size and weight of cupel for each assay. Supposing an estimated five grains of copper in an assay, what weight of boneash will be necessary to absorb the lead and copper oxides from the assay?—GALVANOPLAST.

[52692.]—**Cleaning Sponge Cloths.**—Would some of our locomotive correspondents kindly tell me how the sponge cloths (used by fitters, cleaners, &c.) in the locomotive sheds at Crewe and other places are washed clean? Also position of steam pipes in the boilers, strength of soda, &c., and whether anything else than soda put in the boilers? I have a large quantity to wash, but I never can get them clean through.—[illegible]

[52693.]—**Watch Jobbing.**—Will any of your correspondents kindly inform me how to put a new cylinder into a Geneva watch, and also how to put a balance staff into a Geneva lever watch?—[illegible]

[52694.]—**White Furniture Cream.**—Would any reader kindly give me particulars how to make a good white furniture cream for cleaning and polishing? I have been trying for some time to make one, but cannot. Mine either dries on too quickly or smears the furniture, and will not polish.—[illegible]

[52695.]—**Electric Bath.**—Can any one tell me how to fit up an electric bath? What kind of apparatus to use, and how to apply it for the cure of nervous disorders, particularly general debility?—H.

[52696.]—**Silver Mounts.**—What kind of tools are used to get the frames of cigar cases up—those sort that are made with square tube with the inside cut away, or is the guttering drawn?—GEORGE EVERSLEY.

[52697.]—**Damp-proof Glue.**—Can some of the readers of our paper give me any information upon a formula for putting into glue, rendering it impervious to damp, and sets in three or four minutes so fast that the joints glued cannot be broken. There is an American in this country calling upon cabinet-makers and others offering the recipe for sale, £2 10s. I gave him two pieces of wood, roughly warmed: he warmed them, then warmed a lump of the prepared glue on the stove-pipe and glued the wood, rubbing them well together. In three minutes we could not break the glued joint, though we tried all means. This glue will be invaluable to me, if it will stand any length of time. Also, can any one give me information upon a means lately discovered for making thin veneer so pliable that it can be put on mouldings or any uneven surface as easy as papering it.—ALEX. FINLAYSON.

[52698.]—**Gas for Boiler.**—I have a copper circular horizontal boiler 22½in. long and 10in. diam. It has a central fireplace 6in. diam. running for 20½in. of its length, with a chimney at the end. I propose to heat it by means of gas with atmospheric burner. I should feel obliged to any one who could give me information as to how I could best arrange and make it so as to give out large amount of heat. Would this boiler be large enough to work an engine of 3½in. stroke and 1¼in. bore?—AMATEUR ENGINEER.

[52699.]—**Cement for Pavement Lights.**—Will some correspondent please inform me how to make the best cement for fixing glass in my pavement light? I find many of them are loose, and a source of danger.—C. LISSON.

[52700.]—**German Yeast.**—I want to sponge with a yeast or barm capable of keeping a biscuit-cutting machine going constant, having in hand when starting a batch of 560lb. of dough, which the machine will cut up in about three hours. Would "Cypher," "Cygnet," or any other of our readers, oblige by stating the best yeast to use, the proportion to 280lb. of flour, what temperature to use at when the bakehouse is about 65° F.? Whether quarter or half sponge should be used, and probable time taken before being ready for doughing? I have used compound brewer's and other barms—all good enough, but too slow. I have all information from Vol. XXX. to the present; but find nothing to answer my purpose.—EGO ALPHA.

[52701.]—**Water-Motor for driving Dynamo.**—Would any kind subscriber inform me how to make a small water-motor for driving a dynamo, something after the style of the Thirlmere? Whether a wood case of oak would be strong enough to stand the pressure of 40lb. to the sq. in.? If so, please say the best form for utilising power, thickness of case, and best form of paddles, &c., so as to get all available power.—A. E. WEBBER.

[52702.]—**Water Power.**—Will some fellow-reader inform me what quantity of water per minute will pass through a pipe 9in. diam., with a fall of 1 in 400?—FARMER.

[52703.]—**Sewer Gas.**—I should be glad to know approximately the percentages of the different constituents of sewer gas.—CHEMIST.

[52704.]—**Piano.**—I have a cabinet piano, the case, frame, soundboard, and strings of which appear to be as good as when new: but the action appears worn, and the felt on the hammers, though not cut, hardened with use. The tone is hard, and without much sustaining power: and some of the notes have a disagreeable metallic ring in them. Would a new action improve it much, and how much would it cost? It is six octave, and the action-frame is 3ft. 4in. by 3ft.—E.

[52705.]—**Spiral Wood-Turning.**—Can any person oblige by answering the following? Would a slide-rest be necessary, or is it possible to do with an ordinary lathe for spiral wood turning?—E. JOY.

[52706.]—**Bottle Batteries.**—I want a battery that when charged will remain good for, say, six or eight weeks, so that it shall be ready day or night to illuminate a five-candle lamp for surgical operations. Expense is not an object, so that I propose having two or three two-gallon bottle bichromate batteries, if these will last longer than the ordinary open jars. How long will the bichromate solution keep if the carbons are in it, but the zincs suspended? Possibly I might be six or eight weeks, and not require it, and then at the ninth week want it in a few minutes. Shall I gain anything by the use of the more costly bottle bichromate? Will "Sigma" and your other correspondent who kindly replied to my last, accept my best thanks for their courtesy?—SPECTATOR.

[52707.]—**L. & S.W.R. Brakes.**—I have been informed that the above railway use an automatic steam brake upon their engines, in conjunction with automatic vacuum brakes on train. I shall be glad if some of the numerous readers of the "E. M." will tell me how this steam brake is made automatic.—A drawing will be very acceptable.—H. W. HUDSON.

[52708.]—**Stop for Photo. Lens.**—I have a [illegible]-focus view lens, which will cover a 5 by 4 plate, with a [illegible]in. stop, but with a [illegible]in. stop the light is cut off the corners of the plate. At what distance from lens should stop be placed, relative to focus, single view lens, stop working in front? The rule for any focus would no doubt be useful to others as well as myself, now Mr. Lancaster is placing the lens within the means of most of us.—C. W. CLIFFORD.

[52709.]—**Fire Alarm.**—Can any reader recommend a simple and efficient apparatus for alarm in case of fire, in lieu of the ordinary bell? Are foghorns suitable? What distance can the sound be heard from, and what is the probable cost? Any information will be valued by—INSURER.

[52710.]—**Wheel Teeth Calculation.**—I wish to know by what method I may obtain the following calculation.—Take a given number, say 64,800, and give the rule for finding what three numbers, when multiplied together, will give the above number. The rule also when four or five multiples are required to equal a given number will oblige.—Clockmaker.

[52711.]—**Decoration of Jewellery.**—Will Mr. Widemann, or any other kind reader, give instructions or say where the same may be had for the decoration of the above by means of baths of alkaline plumbates and ferrates?—W. S.

[52712.]—**Coupling Railway Waggons.**—Will any reader give "methods" and full details of coupling waggons, without a man going between the waggons?—Historian, M.I.M.E.

[52713.]—**Painting Engines.**—To "Meteor."—Has the M. Ry. Co. decided to paint their engines brown instead of green, as several brown ones are running?—Historian, M.I.M.E.

[52714.]—**House Chimneys.**—I should feel much indebted to any of your practical readers who would kindly give me their opinion as to the safety or insecurity of chimney stacks of the following proportions: Height from parapet, 9ft.; breadth, 6ft. 7in.; thickness, 18in. The stacks have each three flues, but are constructed of only 4½in. work. They are in rather an exposed situation; but the masonry is good. The recent accidents from falling chimneys prompt me to make this inquiry.—Timidity.

[52715.]—**Steam Launch.**—Being desirous of making a little screw steam launch, would any of the readers of "ours" kindly tell me if I could make the ordinary open rowing boat into one? Its length is 12ft. by 3ft. broad. I should like to have engines of 1h.p. Would this be strong enough to do from 12 to 14 miles an hour on the river. Would any reader kindly also tell me where I could get such fittings? Any information that you can give me I should be most thankful for.—W. W. H.

[52716.]—**Lathe.**—I am availing myself of the clear and practical directions now appearing for making "A Cheap Lathe"; but as I do not intend to shirk the first difficulty, an iron bed, and should like (if successful) to go on improving my lathe, perhaps "J. H." will be kind enough to give the following information—viz., Directions for making, and dimensions of, the arms and other extra parts to casting of headstock for carrying back-gearing and screw-cutting attachments, also short description of the way to arrange back centre keeping the same end in view.—Headstock.

[52717.]—**Wollaston's Battery.**—Will any correspondent inform me what is the matter with my batteries? I have made them in the usual way, and in two or three hours after they were put together the zinc plates went black and gave off gas. I have tried the acid weaker, and also fresh zinc plates, but with no better results; the mercury seems to dissolve off the plates.—H. C.

[52718.]—**Dog Poisoning.**—Will one of our chemical readers tell me the dose and name of the most merciful poison for destroying a very powerful dog, a great favourite, but pronounced unsafe to keep. Local chemists seem very hazy on the point, seeming to know but little of the painless, or otherwise, action of any poison. Would laudanum have painless and sure action?—M. C. H.

[52719.]—**Flooring for Sheds.**—I am about to erect some hundreds of square yards of sheds under which to manufacture chemicals, can any of your readers tell me from their own experience how to form a flooring which shall be water and neutral liquor tight, and be cheaper than flags. There may be some form of concrete which would answer the purpose. Any hints about this matter, together with cost per square yard, will be valued.—P. H.

[52720.]—**Telephonic Patents.**—Can any one tell me if the Bell Telephone and Blake Transmitter is patented in Australia, and if so in what part? Is there a good opening in Queensland for a telephonic engineer starting on his own account? What good instruments, both receiver and transmitter, can be legally used in this country and bought at a moderate price. Is the cup and ball microphone a good and legal instrument for this country.—Telephonic.

[52721.]—**Electrical.**—Would any of your readers kindly answer the following:—How Coulomb's torsion balance is used for the purpose of comparing the quantities of electricity in the same Leyden jar on two different occasions? Also the formula in Ganot's "Physics," page 646 and 647, for charging by cascade arrangement. I am not a mathematician, and should be obliged if your readers would give results in arithmetical numbers, and not mathematical formulæ.—R. R. R.

[52722.—**To Mr. Lancaster.**—I am making a battery of twelve cells, two copper plates and one zinc; the coppers are eight by six, and the cells are wood, charged with sulphuric acid and water. Would it be best to line the cells with sheet lead inside or paint them with pitch, and how many incandescent lamps will it light, and how long will the battery last?—I shall be much obliged.—Z.

[52723.]—**Chimney.**—I am about to erect a chimney for a works, and should feel obliged if you would direct me to any previous articles in your journal bearing on the matter, or to any good book containing the requisite information. Failing this, some of your readers might be able to help me. The one proposed to be built is to be about 60yds. high, but sufficiently strong to carry another 20 if found requisite. What I want is the proper bottom and top inside diameters, and thickness of walls; to what extent a firebrick lining should be used. Also information about the requisite precautions to secure a sound foundation? what are the relative advantages or otherwise of the round, square, or octagon form? The chimney in question will have to carry away the products from about 150 tons of coals per week.—P. H.

[52724.]—**Detaining Luggage.**—Would any legal friend express opinion as to the right of a tradesman to detain luggage under the following circumstances? A., on a visit at a watering place, buys frequently small items at a grocer's, B., and pays cash down, taking no receipt. Shortly before A.'s departure B. sends in an account for a few shillings said not to be paid for goods on a certain day when obtained as usual. A.'s cash book shows the items were paid for. B. on morning of A.'s quitting meets A. at railway station and threatens to stop a trunk "as the law permits." A says: "Do it at your peril," and B concludes "not."—M. C. H.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 9, and unacknowledged elsewhere:—

J. A. Campbell.—H. Trick.—W. Nolan.—Maynard and Harris.—W. H. Sellens.—Blakey, Emmott, and Co.—R. Prentice.—E. J. Piper.—South London Machinists' Co.—G. J. Hewson.—J. Place.—E. M. Richards.—Rev. Dr. Richards.—A. J. S. Compton.—T. Barker and Co.—M. D.—C. J. N.—R.—W. J. Grey.—E. Beaumont.—O.—Chemicus.—D. Williams.—Unsuccessful.—M. A.—Delta.—W. H. E., Coventry.—A Blacksmith.—J. E. Floyd.—W. D. B., Dublin.—H. R.—Inventor.—T. J. O'Connor.—A Sheffield Workman.—W. Jones.—Clock.—X.—Shakespeare.—T. Usher.—A Fellow of the Royal Astronomical Society.—Leonard Marshall, M.A.—J. Copcutt.—H. Sadler.—C. E. Stretton.—Model.

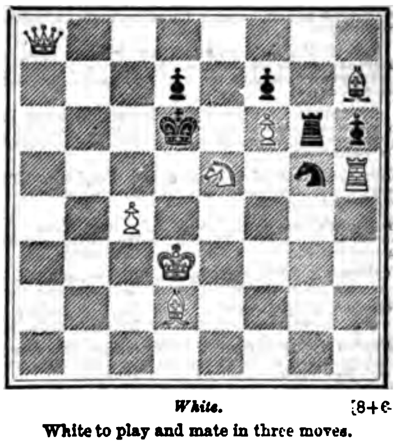
W. M. B. and Anxious. (Paint for blackboards has been given several times. Some recommend staining—ebonising in the way described the other week, and rubbing over with heel-ball until glossy. Others paint with several coats of lampblack, the last being mixed with turpentine only; another recipe gives finely powdered coke as an addition to the black paint. On p. 188, Vol. XV., there are two recipes for "liquid slating" for blackboards, which are shellac varnishes to which powdered pumice or fine emery is added, and lampblack or ivory black. See also pp. 168, 190, Vol. XV.)—S. Taylor, Leicester. (If it is a Rubens, you should communicate with Mr. F. W. Burton, director of the National Gallery, Trafalgar-square. If there is any likelihood of its being genuine he will no doubt send an expert to see it.)—Thistle. (See list of Back Numbers in this col. last week—Copying Processes. You have inverted the proportions of glue and glycerine. It should be 1 glue to 4 glycerine. Add whiting to give body and colour. 2. Should be all wool.)—J. A. C. (We answered your query on p. 332, middle col. The watch wants timing and adjusting for position, as has been explained many times. If your watchmaker does not know that, take it to another man.)—M. P. H. (Indiarubber dissolved in bisulphide of carbon or mineral naphtha.)—E. Webb. (1. Directions for making batteries in many numbers—the last, for instance; but see the list of Back Numbers. 2. If the notice is legal, quit at the time appointed, and pay the rent due at the time.)—A. P. S. (There is no book on the subject; but you will find articles in the cyclopædias, and some replies on the subject in recent numbers. We are not aware that there is any new process.)—P. (Sharpening and setting saws in Vol. XXXVI., pp. 296, 5:5, with illustrations.)—W. L. Willis. (See the indices. Nos. 16 or 18 for primary and 34 or 36 for secondary. 2. The duration depends on the work it is made to do. 3. We cannot say. We do not know any one who has measured such a cell. You seem to have forgotten the manganese.)—W. Thompson. (Your sample appears to have been prepared by spreading over it a solution of pitch in mineral naphtha, mixed with boiled oil; but it may be gas tar asphaltum boiled with linseed oil and thinned with turpentine.)—Tricyclist. (Similar request inserted. 2. Several have been given.)—P. Ward. (Kindly read the heading to "Unanswered Queries." It will be entered in due time if not answered.)—Astro. (The compass is of very little use for such a purpose. We have given several methods; perhaps the simplest is that on p. 568, No. 909.) Nil Sine Causa. (You must get some one to take a copy to Stationers' Hall, fill up the form, and pay 5s.) E. Robinson. (Answered very recently—see replies to 51944. The other method is with copper bronze powder mixed with varnish—Bessemer's paint.)—Keen Lover of Music. (You can find them in the lists or in the Post Office Directory; but as a matter of fact any newsvendor who understands his business will not only tell you the titles, but offer to get copies for you.)—Coup d'Essai. (It depends on what you want to do. If for bell-ringing over a long wire, connect zinc of one cell to carbon of the next.)—Paul Changer. (We can only refer you to some elementary textbook, for without knowing what you mean it is waste of time to guess. Perhaps the reflection that no one would use the secondary if he could get the effects with the primary, may solve your difficulty.)—Learner. (See some of the handbooks of the art, or look up our back volumes. We cannot afford space for queries which involve replies that may or may not be answered owing to the indefinite nature of the question.)—Ignorant. (Kindly look at the subject in back numbers. See the Edco Battery, p. 379.)—One Wishful to Learn. (What is the matter with them? You can learn by reading the plain instructions on pp. 180, 244, 553 of the last volume.)—A Six Months' Subscriber. (Will do for the return—that is all. You must have a line wire for the current to the bells. 2. The only books we know are Spretson on "Casting and Founding" (Spons), "The Brass-Founder's Manual" (Lockwood and Co.), and Overman's "Moulder's and Founder's Guide" (Sampson Low.)—Volt. (It is shown on p. 101, Vol. XXXIII.; also in another form on p. 565; but why not go into the Patent Office Library and read the specification.)—G. R. B. (Queries asking for full particulars of an electro-motor without stating the size cannot be inserted. You will find several illustrated in back volumes, and can take a choice, so as to pick that one which will be easiest for you to make. How will the one on p. 95, No. 914, do; or that in No. 908, p. 554?)—Unique. (An "electric motor for driving a lathe," is not definite enough. What size lathe, and what work is the lathe to do? However, see previous answer, and look through the indices.)—J. K. (Leclanché cells are not suited to electric-lighting purposes. 2. If you mean what would be the cost of lamps of the power specified, it would be more than the same light from gas.)—Aurora. (Have you referred to the back Nos. given in the list which appeared in this column last week? You want different sized wires to those you have.)—Impudent Telegraphist. (At any dealers in such material. See our advt. pages. 2. The question is not clear, but we suppose they are soldered. 3. Several, we believe; but the hand-stamping is preferred.)—Pain in the Chest. (Would you really take anything and everything that might be guessed? Better consult another medical man, and tell him as near as you can what did you so much good before. You must recollect that you are older.)—W. Watson. (Not possible, without sacrificing something. The usual size has not been adopted for nothing; but look up the subject in back numbers, and you will probably find something to suit. There must, however, be something like the present length.)—A Youngster. (All you want is a simple revolution indicator which is applicable to any sized wheel. A table, easily calculated, shows how many revolutions are equal to a mile. If you must make it indicate the distance, you will find the method of calculating trains in several back numbers, or you could get the idea from a gas-meter index. Doubtful whether any of the "movements" you refer to could be utilised.)—W. F. James. (A variety of ellipsographs have been illustrated in back volumes. See p. 593, Vol. XV., p. 60, Vol. XII., p. 448, 548, 595, Vol. XI.; also in earlier volumes. See Stanley's book on "Drawing Instruments.")—G. M. or S. M. (For painting lantern-slides, see p. 226, last volume, and the indices generally.)—Miller. (An Otto gas engine would be much the more economical of the two, and so much cleaner—a consideration in your case. Makers would give all particulars as to size of main, &c.)—A. Mee. (In type).

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXIX.—By G. J. Slater.

Black.



White. (8+6)

White to play and mate in three moves.

Solution to 867.

White.	*Black.*
1. Q-Q Kt 7	1. Anything
2. Q or Kt mates	

(4 variations.)

NOTICES TO CORRESPONDENTS.

Correct Solutions to 865 by S. Farnsworth; to [illegible] by Rev. W. Anderson (Old Romney); to 867 by A. Schmucke, J. G. Elliott, X. Y. Z., R. A. Bennett, Rev. W. Anderson.

G. H. M.—Thanks for the game. We are sure our readers will enjoy it.

R. A. Bennett.—Your name is duly entered. Any one can compete in both two-move and three-move Solution Tourneys.

Devonshire Squire.—The extract you have kindly sent is interesting; but we regret that we have no room for it. There are still several Tourney Games in hand.

S. Farnsworth.—We fail to see the mate in 866 if

$1.\ \frac{\quad\quad}{\text{K-K 4}}\quad 2.\ \frac{\text{Kt-B 6 (ch)}}{\text{K-B 4}}$

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 18, 1884.

AMERICAN LOCOMOTIVE PRACTICE.*

ALTHOUGH the average speed of trains in the United States is some 20 per cent. below the mean speed of trains in this country, all things considered, the service controlled by the American engineers compares favourably with any in the world. There is, we need scarcely say, a considerable difference in the conditions, both with regard to the engines and the carriages, and also in the matter of road—a most important factor when high speeds enter into the question. The American style of carriage is well-adapted at all events for the long-distance journeys; but just as there is little reason to imagine it will ever be adopted here, except in special circumstances, so there is some reason to think that in what we may call their local or metropolitan service, American railway managers may, before long, adopt the English or common pattern, with improvements suited to the tastes of their patrons. The question as to which is the best style of locomotive has long been debated by engineers in this country and America, and recently a suggestion was made that a first-class English engine should be bought by some of the American companies and tested on their lines against the best locomotive produced in their shops. Probably the best locomotive has not yet been devised, even for any given section of line and class of traffic, and it is certain that locomotive designers in this country have not arrived at finality, though it may very well be doubted whether some recent changes in matters of detail are altogether improvements. The American engineers at first copied English builders and made locomotives with single drivers; but, as is their wont, they quickly made improvements, and we are not disposed to dispute with Mr. Edwards the dictum that the American locomotive of to-day is "one of the most perfect pieces of mechanism wrought out by the hand and mind of man." We must, however, be allowed to say that another of the "most perfect pieces of mechanism," &c., is the English locomotive of to-day — though "most perfect" must be taken really in a comparative sense, for the locomotive, whether in the United States or in England is not quite perfect, though wonderful enough to those who really understand its construction. The standard passenger locomotive of the American lines has four-coupled drivers with a leading four-wheeled bogie truck, the latter arrangement having been apparently first introduced—at least so far as a four-wheeled leading truck is concerned—by Mr. M. W. Baldwin, in an engine he built for Mr. E. L. Miller in 1834. For freight trains, engines having six and even eight coupled driving wheels are used; but, as a rule, in those cases the front is carried by a two-wheeled truck. In the standard, or "American," engine, as it is called, the drivers rarely exceed 5ft. 6in. in diameter, and very frequently are nearer 5ft., but latterly, for fast traffic, some standard engines have been built having drivers of 6ft. 6in. diameter; and at least one well-known engineer considers that for certain fast lines single drivers of large diameter would be better than the present rather small four-coupled wheels. The standard type has undoubtedly done good work; but it is not unlikely that before long the American builders will return to some of the models that were made in 1849. About that time several locomotives were built having 7ft. single drivers, and at least seven having single drivers as large as 8ft.; some of these last having the rather extraordinary cylinder dimensions of 13in. diameter by 38in. stroke! For the last three or four years, engines having single drivers of 6ft. 6in. diameter have been used to work the fast trains on the Bound Brook route between Philadelphia and New York, and as the gradients of the line are easy, and it seems fast trains will pay, there is a possibility that Mr. Barnet le Van's idea of 90 miles an hour will be accomplished some day. A glance at the railway map of the United States will show, as the fact is, that there must be considerable rivalry between the lines running to Philadelphia from New York, or rather Jersey City, and as one route is about a mile or so longer than the other, it was considered an achievement for the Reading railroad to do the journey in less time than was taken by the Pennsylvania line. Between the points where speed can be maintained the average rate for one train was 57·6 miles, and of the other 49 miles. Since that trial the Pennsylvania line has done better, and now runs the fastest train in America over a distance of ground—the fastest in the world for a journey of more than 900 miles. The United States is the country of long distances, and has the advantage of a "limited express" with a journey of 912 miles, and only seven stops, which is accomplished in the excellent time of just less than 25½ hours. It must be remembered in considering this performance that not only does this train slow through many junctions, but it also crosses many busy streets and passes through several towns on the level, so that after getting beyond Philadelphia, a run of twenty miles without checking the speed is rare. The run from Jersey City to Philadelphia is the fastest portion, and is accomplished at an average speed of 45 miles an hour, while the remainder of the journey is run at an average of 34 miles, the mean rate over the whole 912 miles being 35·29 miles an hour. The stops are made at the ends of the sections to change engines, which are mostly of the standard four-coupled type, but with 6ft. 6in. drivers. They weigh, roadworthy, including tender, 74 tons; and as the train usually consists of five Pullman sleeping cars and one dining car, the total weight to be hauled is about 274 tons. Throughout the journey the speed is continually varying from 30 to 60 miles an hour; but on the clearest portion of the line the rate for a few miles is about 70. The firebox of the engine used for work of this kind is about 10ft. long; so that the fireman must be an expert in his way to keep the fire level and bright and the steam gauge steady at 130. An injector is used to feed, and is kept continually at work during the trip. We think that most railway men will agree with us that this journey of 912 miles in less than 26 hours will compare well with any run in Great Britain, when the conditions are considered, and it is in itself sufficient evidence that the locomotive engine in the United States has reached a high degree of excellence. Those who wish to obtain, as it were at a glance, a good idea of American locomotive practice will find it in Mr. Edwards's book, the title of which we give below, for on one page we have seventeen little diagrams of the engines shown at the Centennial Exhibition held in Philadelphia in 1876, and the following pages give in table form the measurements or other particulars necessary to form a complete idea of the various types illustrated. Mr. Edwards's work forms, in fact, a textbook of the locomotive specially adapted to American practice, and is an all-sufficient guide to the workman and to the designer. In his chapter on the link motion, the author falls into the error of attributing that almost invaluable invention to George Stephenson. The fact is that in 1842 a Mr. Williams, a gentleman apprentice in the works of R. Stephenson and Co., suggested something of the kind; but the link-motion, as we know it, was worked out by Mr. W. Howe, at that time an *employé* of the Messrs. Stephenson and Co., who was rewarded by the present of twenty guineas. Mr. Hutchinson, the manager of the works, seems to have had something to do with the invention—he is credited with suggesting the notches in the quadrant—and there is also a claim for Mr. Jackson, a miner, who is alleged to have given the idea to Howe. Be that as it may, it is certain that Mr. Williams conceived the original idea, and that Howe was the first to exhibit a really practicable model. The Stephensons had nothing to do with it beyond giving it their countenance. In Vol. XIV., the question is ably argued out, and on p. 328 of that volume will be found a diminished copy of the original drawings sent to the North Midland Co., in order that they might apply the link motion to their engine No. 71, the first that was fitted with the link. Besides the matters which belong exclusively to the locomotive, Mr. Edwards's book contains much useful information relating to workshop practices, and the tables which he appends complete a volume which, we doubt not, will be of great assistance to the future locomotive designers, drivers, and firemen in the United States. Forney's "Catechism," which was published in 1875, and which we reviewed on p. 601, Vol. XXI., is a work which is more purely practical; but Mr. Edwards has endeavoured to instruct his readers in the theory and the principles of the practice, and with these two books in his library the student will have little difficulty in understanding that wonderful creation of mechanical genius — the modern locomotive.

ELECTRO-MAGNETS.—II.

By JOHN T. SPRAGUE.

(Concluded from page 355.)

18. THE maximum attractive power to be developed in iron was found by Joule to be 200lb. per square inch of core, which is equivalent to a force of 13,800,000 dynes per centimetre. Prof. Rowland gives the capacity of iron at 1,390 C.G.S. units per cubic centimetre; but various authorities range from 400 to 1,000 for steel, and, as will be understood from secs. 15 to 18, each quality of iron has its own specific capacity, to be ascertained only by experiment.

19. The selection of the suitable size of wire is governed by the resistance of the rest of the circuit. For maximum work, the resistance of the magnet should be equal to that of all the rest of the circuit, including battery. For rapid action, as in a vibrating armature or telegraphic relay, the resistance is made much lower than this, to prevent the counteracting influence and damage of extra currents. But it should be understood that "resistance" is employed in this way merely as a mode of measuring and comparing the wires of different sizes and lengths, which can be put into the helix of required dimensions. Resistance, as such, must be kept down by using high conducting wire.

20. Various formulæ are given to determine the sizes of wire required; but I prefer, for the sake of general readers, to deal with the subject physically rather than algebraically. A helix is a certain space which

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* Modern American Locomotive Engines. By EMORY EDWARDS, M.E. Philadelphia: Henry Carey Baird and Co.; London: Sampson Low and Co.

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[illegible] only [illegible] taking the space [illegible] and [illegible] the square of the diameter [illegible] with the [illegible] external area, and [illegible] length given [illegible] weight as [illegible] copper. [illegible] may be made [illegible] size [illegible] wire and the nature of the covering and also with the skill [illegible] winding [illegible] helix. In the [illegible] it will vary from [illegible] gauge. The [illegible] multiplied by these ratios will give the actual weight of metal which can be placed [illegible] the helix.

21. Having thus the weight of metal at disposal, W, and the resistance it is to give, R, we can ascertain the diameter of wire to be used. In fact, a rule-of-three sum will give us the [illegible] —

As W [illegible]

A reference to the table given in No. [illegible] of the present volume will then show the suitable size of wire, or it may be calculated from the constant of 1 mil. wire [illegible] = square of area in mils. of [illegible] the [illegible] wire.

Therefore, the square root of the quotient gives the area, and the square root of this the diameter.

The logarithmic calculation is exceedingly simple, as it consists only of deducting the logarithm of the [illegible] per lb. from [illegible] and dividing the remainder by [illegible] which gives the logarithm of the diameter required.

22. The simplest mode of ascertaining the [illegible] is to prepare a [illegible] in which [illegible] wire. [illegible] these. [illegible] turns per [illegible] wire will [illegible] which would [illegible] is the [illegible]

[illegible] be considered in [illegible] the definite [illegible] be required to perform [illegible] expenditure [illegible] be measured in foot-[illegible] of the magnet [illegible] current passing it will [illegible] which, for the time [illegible] resistance added to that due [illegible]. In designing the electro-[illegible] necessary therefore to arrange [illegible] to the dimensions which [illegible] attractive power which is [illegible] necessary. Then to adjust [illegible] wire and its resistance to the [illegible] of the circuit, because, while a [illegible] wire may give the required conditions [illegible] a fine wire may be [illegible] any considerable distance. [illegible] battery power must be arranged [illegible] merely the current required to [illegible], but the electro-motive [illegible] to pass that current when [illegible] doing work. It is here that [illegible] usually arise.

[illegible] a battery and magnet with a [illegible] in circuit, and note the current [illegible] the magnet work to do in [illegible] weight, and the same current [illegible]. This seems a paradox, [illegible] should pass when it [illegible] work than when it merely tra-[illegible], but it is easily explained. [illegible] and magnet have each a [illegible], and the battery an [illegible] to pass a current of [illegible] for the con-[illegible], that the added [illegible] the current [illegible]

Then [illegible] that the work is equivalent to a [illegible] added to that of the wire. Now the energy expended is in the ratio of $C^2 \times R$, be the resistance of what order it may. Hence, we have, at first energy supplied by the current $3^2 \times 2 = 18$ joulads per second.

Under the second conditions, we have it $2^2 \times 3 = 12$, less energy supplied by the reduced current to the increased resistance.

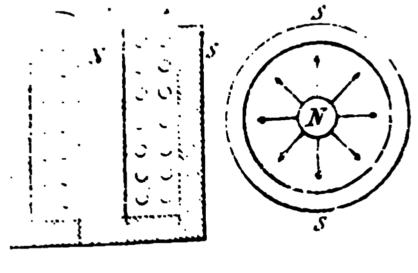
But in the first case the whole 18 joulads are expended in heating the battery and wire; in the second case, only 8 are so expended, while 4 are employed in work.

25. If, then, the magnet is so arranged that it will require 3 ampères to do its work, it is evident the E.M.F. must be increased in proportion to the extra resistance represented by the work; it must, therefore, be raised to $C \times R = 3 \times 3 = 9$ volts, and then we shall have energy $3^2 \times 3 = 27$ joulads, of which 18 are used in battery and wire as before, and 9 remain to do the mechanical work. Therefore, in all cases, the battery must supply the current required while work is doing, not merely that calculated from the measured resistances.

26. As usually constructed—that is, in the horseshoe form—the electro-magnets do not utilise all the magnetic effect of the current, which acts externally as well as internally, but in the opposite direction. The armature is magnetised, of course, but only by induction from the core, and part of the power must be diverted to the external field of the helix. This external power may be utilised in various ways.

27. A few years ago, great claims were made as to the advantages of surrounding the helix with an external tube of iron connected to the core at the lower end by a disc of iron. This was patented under the name of the "[illegible]" magnet—a barbarous word invented to convey some idea of exaltation; but the construction had been frequently employed before. Fig. 6 will explain it.

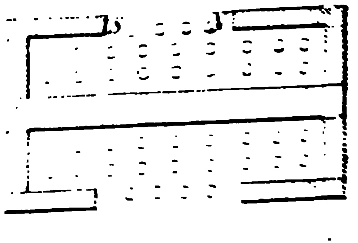
Fig. 6.



It will be seen that though there is only one core, this is still a true horse-shoe magnet, the other arm being a cylinder surrounding the core. The effect is to produce an intense, but very limited, field, represented by the arrows, giving, no doubt, great holding power, but with attraction exerted only at a small distance.

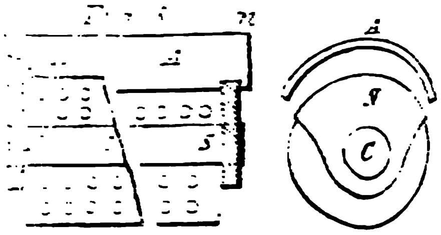
28. A modification of this is employed in some electric bells, which is shown in Fig. 7.

Fig. 7.



In this a cylinder is placed on each end and the opening in which the [illegible] is produced is at the middle of the core. The cylinders should be more open at the lower side, as shown in dotted lines, in order to concentrate the polar forces in the upper part where they can act on the armature.

28. Perhaps the greatest power may be obtained by a further modification of my own, in which the external action of the current is taken up by the armature, which is thus magnetised by the current, as well as by induction. Fig. 8 shows this:—



C is the core, fitted with two pole pieces, N, S, extending over one-third of the end of the helix: A is the armature in which the outside action of the current produces poles *n s* opposed to those of the magnet, so that a powerful attraction draws down the armature which is made as part of a cylinder fitted to the pole pieces.

OBJECT-GLASS WORKING.—X.

By "[illegible]."

THERE must be great care used, if dry polishing is adopted, to remove all grease from the surface of the lens. To insure this, as well as to cleanse the surfaces for examination, a weak acid dip is used after the smoothing. This dip is applied with a sponge and washed off afterwards with clean water. The proportions I find effective are 1 part of sulphuric acid B.P. to 6 parts water. It will astonish those not used to this, to find what a number of occult scratches and other defects are brought to light, when the deceptive top glass got in smoothing is dissolved off. It is not possible to give the time required to polish a given sized surface, but two considerations are here given. First, there is a little loss of light if the glasses are not so highly polished as the metal will permit. Second, the longer the surface is [illegible] the more the marginal error will increase in the hands of the inexperienced. It is very important in either method of dry polishing to keep all [illegible] as we are working. It is well also to brush the polishers every half hour with a soft brush, to remove the glass which adheres to the paper as it is polished off the lens. The method, when the stationary tool is used, consists of a continuation of straight, or straight varied with elliptic, strokes, keeping up an even pressure and a gradually increasing rotation of the lens. The thumbs and two first fingers of both hands will give the necessary pressure as well as can be given. With the [illegible] polisher the left hand is occupied with the wheel handle. The right hand only can be used for holding the lens: the thumb and three fingers are used, the tips of them being [illegible] sufficient to keep the lens down. For the [illegible] lens in this case the lateral stroke can bring the lens one-third of its diameter outside the margin of the tool with advantage. The rotation must be kept up, increasing from, say, [illegible] rotation of the lens to five turns of the wheel to [illegible] rotation to [illegible] turns of wheel to finish with. Paper, although giving [illegible] yielding surface, can be made with the [illegible] to give an elliptic, or even a parabolic, figure. The [illegible] at which the pressure affects the surface I use as a factor [illegible]. It would be impossible to give [illegible] that can be made in the [illegible]. It will, perhaps, assist the [illegible] how a concave surface may be [illegible] say, a parabolic figure by [illegible] pressure on the edge. A cork of the same [illegible] as the lens is used, with parallel sides and about [illegible] high. The "cake" [illegible] this cake at the edge. The polishing [illegible] until the test shows we are right [illegible] or under-correction is [illegible] a larger cork can be used, and the [illegible] be [illegible] in zones near the centre of the *rotating* tool. If a stationary tool be used, the polisher can be widened, or, rather, a wider one put down, of the same paper as the original one we began with. By acting upon this illustration, it will not be very difficult to so regulate or proportion the size of the cork back that, in conjunction with a suitable position on the rotating tool, or a suitable width of polisher on the stationary one, we can give our surfaces the needed figure. I do not see that by any possibility measurements can be of anything more than approximate value, every slight difference acting, as it does, in so greatly altering results. Minute differences in paper thickness, differences of pressure by different hands, even the temperature and pureness of the powders used, are each and all productive of great deviations from any laid-down rule. I do not state this to deter, but rather to incite to experiment.

Years ago it was my privilege to work with one of the great Dollond's o.g. workers. I confess that as I look back I am surprised at the comparatively primitive method, or rather want of method, that prevailed in the old days, and yet what good results were obtained. The mode was simplicity itself compared with the elaborate machinery of the present day as used in our best firms. I think a description in brief will interest our readers, so I will endeavour to give it.

The lenses, roughed up as usual, were cemented on an iron back with pitch: these backs each had a screwed boss, so that they would screw on a post set firmly in the floor. The tools of brass, the same size as the glass, also screwed on this post. The convex lens, smoothed beautifully (at the top), was now screwed on the post in place of the tool. A strip of lutestring silk, about four-fifths the diameter of the convex lens, was stuck down on the tool with a mixture of pitch and turpentine; when this was dry a good "seasoning" of putty powder, shaken out of a pepper-box, was applied and well wetted and rubbed into the silk. A wooden handle was screwed in the boss of the polishing tool, and the polishing, figuring, and finishing commenced. A regular sweeping stroke, showing the centre of the lens each time, was applied for a few hours, and then the lens was "knocked off." The same process did for the concave lens, with the exception that it was kept upwards and the tool was entirely covered with silk. Now came the testing, first on the dial. If it did not define *that*, one side after another was resmoothed and repolished until the dial (a good watch dial, with a very small name on it) was defined. Then came the star testing, which was a repetition of the other. Smooth over and polish over until good enough, with occasional flattenings and deepenings for colour correction, as alterations were made in the tools through the continued working. With regard to the method used for centring the lenses, which was done on a hollow mandrel, I do not think much improvement can be made upon it. This description will show that there must be individual skill at the botton of it all, or it is questionable whether even a good result could be got. Much pluck and patience and great powers of endurance had this old gentleman, and very good are his glasses, even now-a-days.

(*To be continued.*)

MANUFACTURED BRANDY.

UNDER the title of improvements in the manufacture of alcohols a patent has been granted in this country to an invention which is intended, by reducing them, to facilitate the removal and shipment of alcohols, and also to convert a quantity of plain spirit into Cognac brandy. The invention is a communication from M. Adrien Ralu, jun., of Ermont, France, and the patent covers several processes, for the result desired may be obtained in different ways —e.g., by distillation, or by raising or lowering the alcoholic strength by means of spirits having a flavour similar to that of Cognac, by the addition of essences and ethers, by maceration, or by lowering the degree of alcoholic strength by means of fruit juices. In operating by distillation, 1 kilogramme of juniper berries, 10 kilogrammes of prunes, and 1 kilogramme of orange blossom are added to every 100 kilogrammes of grape pulp that is to be distilled. This is left to macerate 24 hours, it is then distilled, and afterwards about half a litre of pure glycerine is poured into the alcohol thus obtained. In operating by reduction of the degree of alcoholic strength by means of spirits, for every 100 litres of superior corn or molasses spirit of 95° to 96° alcoholic strength by Gay-Lussac's centesimal alcoholometer, 13 litres of rum, 6 litres of cherry spirit, and 4 litres of Hollands gin of 49° to 50° strength when mixed are added, thus bringing down the strength of the whole to about 90°. Half a litre of pure glycerine is then added. In the process by raising the degree of alcoholic strength, the reverse is the case—i.e., rum or Cognac of 54° to 55° strength is brought up to 90° by the addition of superior corn or molasses spirit, and afterwards adding per 100 litres of this mixture, 3 litres of cherry spirit, 1 litre of Hollands gin, and half a litre of glycerine. In operating by addition of essences or ethers, for every 100 litres of alcohol of 95° to 96° strength by Gay-Lussac's centesimal alcoholometer, 12½ centilitres of essence or ether of Cognac, commonly sold under the name of flavour or essence of brandy, and a half-litre of pure glycerine are added; the whole is then macerated with 10 kilogrammes of prunes for about a fortnight; it is then strained and filtered. In operating by maceration, for every 100 litres of alcohol as above 15 kilogrammes of prunes, 250 grammes of juniper berries, and 125 grammes of black tea are added, and the whole left for about a month to macerate, after which it is strained and filtered and half a litre of pure glycerine added. In operating by reduction of the degree of alcoholic strength by means of fruit juices, for every 100 litres of alcohol of from 95° to 96° 12 to 15 litres of pineapple juice and 1 kilogramme of pineapple skins are added; the whole is left to macerate for about a fortnight, it is then filtered, after which 4 litres of Hollands gin and half a litre of glycerine are added. By adding an equal quantity of water to alcohols obtained as above, they are, according to the patentee, changed into Cognac of quality varying according to the nature of the ingredients used.

THE LATE MR. J. H. DALLMEYER.

THE death is announced, in his 53rd year, of Mr. John Henry Dallmeyer, optician, whose name has been long associated with the production of some of the best optical work in England, especially lenses for different branches of photography. In 1849 he left Germany, his native country, and came to England, entering the house of the late Andrew Ross, the founder of the well-known optician's business bearing his name. Mr. Dallmeyer's attention was at first devoted principally to the construction of telescopes, for which, in conjunction with Mr. Ross, he computed a large number of formulæ. At his death, Mr. Ross bequeathed to Mr. Dallmeyer the bulk of his optical appliances for the manufacture of astronomical telescopes. About this date (1855) photography began to be popularised by the general adoption of the collodion process. Mr. Dallmeyer quickly discovered that the photographic lenses then in use stood in great need of improvement in every direction. In rapid succession he produced lenses for landscape and portrait photography, and it is greatly owing to his efforts that English lenses now rank second to none. He was specially commissioned to provide several of the telescopes and photographic appliances used by the different Government expeditions for the observation of the recent Transit of Venus, and his telescope object-glasses are in high repute among the leading astronomers. For some time past his health had been precarious, and, whilst taking complete repose from work, on the voyage to New Zealand, he died on the 30th ult.

ALCHEMY AND MODERN SCIENCE.

THE following is an abstract of the last three lectures of the series delivered by Prof. Dewar, F.R.S., at the Royal Institution on "Alchemy in Relation to Modern Science." (See pages 382, 406.) Prof. Dewar began by reminding those who had followed the history that hitherto chemical research had been extricably mixed up with other extraneous matters, such as physical and metaphysical speculation about the constitution of the universe and so forth. This alloy added very much to the difficulty of the inquiry, which was further complicated by the fantastic notation employed by the alchemists from very early times in speaking of the things of which they treated. They used a secret language in teaching their occult science. Water and the other elements had each its own symbol. Each of the seven metals was denoted by the symbol of one of the members of the solar system as known to the ancient world, gold by that for the sun, silver by that for the moon, and quicksilver, copper, tin, iron, and lead by those for the planets Mercury, Venus, Jupiter, Mars, and Saturn respectively. Moreover, each had its mystical relation to its day of the week. These, together with the letters A B R A C A D A B R A, arranged in a sacred triangle and curious applications of the Pythagorean doctrine of numbers, were freely used by those versed in that Cabalistic lore which was traced back to Adam. The names of some of the writers on alchemy and titles of their works were cited. Zosimos wrote, "On the Divine Water" and "On the Method of Confecting gold;" Heliodoros, "Of the Sacred Art of Chemistry;" Theophrastos, Archelaos, Pelagois, Ostanes, "Of the Sacred Art;" Hierotheos, "Of the Stone of the Philosophers" and "Of Gold-making;" Olympiodoras also wrote "Of Gold-making." The Arabs were wonderful compilers of such learning, which from them passed through the Moors into Spain and the whole west. The words alkali, alcohol, borax, and many other chemical terms were Arabic. This literature proved that the alchemists had added to vinegar and other vegetable acids the spirit of nitre and the spirit of ammonia or salt. They had found that, as shown by the lecturer, the spirit of nitre (our nitric acid) would dissolve all the other metals known to them, but would not dissolve gold, which, however, yielded to what they termed *aqua regia*. This was nothing but a mixture of the spirits of nitre and salt (our nitric and muriatic acids). They knew besides that by the union of acids and alkalies fresh substances, unlike either, were formed, which they termed salts, as we did still. Nor were the ancient alchemists ignorant of the result of the action of the acids on metallic calces, the name given to the residuum left in the crucible after the roasting of the metals. On treating a calx with an acid they found that a solution resulted identical with that produced by dissolving in the acid the uncalcined metal. Experiments verifying these elementary but momentous conclusions, already reached by the alchemists, were repeated for the instruction of his youthful audience by Prof. Dewar. An experiment of another kind, namely, the coating of iron with copper by plunging it into an acid solution of the latter, it was remarked, might have fostered the delusion of the alchemists about the transmutation of the metals. Of course, a fresh application of the acid to the copper coating proved to the young students how baseless was the fancy. After a reference to Roger Bacon (1235) as the first great English alchemist, the lecturer reminded his audience that the real starting point of modern science must be dated from the investigation of the laws of motion by Galileo and Kepler, whose discoveries culminated with Newton. Galileo in 1639 discovered that the vibrations of the pendulum, short or long, take the same time, thus giving us an exact measure of time. The discovery led up to its use in determining the shape of the earth as well as our planet's density, and in demonstrating its rotation on its axis. The lecturer concluded with an eminently successful repetition of Foucault's experiment in 1851, the seeming deflection of the pendulum, taken on a measured scale, minute by minute and always in the same direction, proving to demonstration the real diurnal motion of our planet.

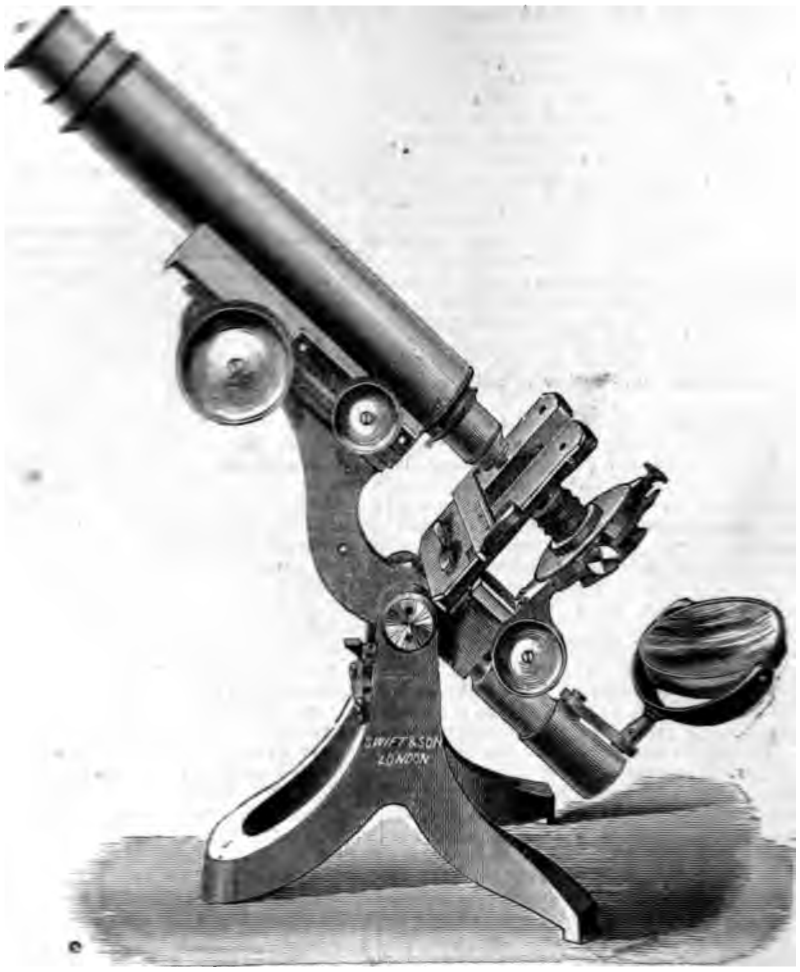
In his fifth lecture, Prof. Dewar spoke of Newton's sublime demonstration, that the laws of motion extend not only to all the heavenly bodies, but also to molecular changes with which chemistry is concerned. But they had not yet done with the workers before Newton. Of the alchemists belonging to the thirteenth century Raymond Lully was reputed to have transmuted 20,000 tons of lead into gold, a tradition needing no comment, save that a quarter rose noble passing as one of Lully's was afterwards exhibited, which Prof. Roberts, of the Royal Mint, guaranteed as the purest gold. On the same high authority it was believed to have originally existed as an alloy of a far larger mass of silver, which having been separated by the action of nitric acid, the virgin gold was left behind. In this connection an experiment prepared by Prof. Roberts was performed, showing the newly-discovered peculiarity of gold, that after cooling down from a fiery fluid into a dark solid it suddenly flashed forth into more that it former brightness Another alchemist in the same century actually mounted the papal throne—namely, John XXI. Roger Bacon was the third great light of that age. Paracelsus, to whom the healing art owed so much, came two or three centuries later. It was he who first introduced the use of the metal antimony in medicine. A series of slides photographed from authentic sources were passed through the lantern and thrown on the screen to illustrate the apparatus and experiments of the alchemists. First came a rudely drawn furnace for the distillation of wood, then, amidst dragons and other mystical [illegible] experiments, notably by the decomposition and recomposition of water. The wire carried the [illegible] sparks, keeping red hot and even emitting light under water so long as the fire was discharged from the battery. By means of this new agency Davy split caustic soda, till then deemed an elementary body, into the metal sodium and the gas oxygen, following up this discovery by adding the [illegible] alkaline metals to the short list of those known to the ancients. This was an immense achievement, but it was a far greater that he had invented and set to work so [illegible] and powerful an engine of chemical analysis. Mention was made, also, of Mr. Justice Grove's [illegible] experiment for resolving steam into its constituent gases, hydrogen and oxygen, by passing it over the white hot spirals of platinum wire. The remainder of the lecture was devoted to analysis by the spectroscope, profusely illustrated by experiments.

TOOTHING A NICKING SAW.

THE nicking or cutting off saw in the machine shop is a necessary tool for many purposes, but, unlike knurling tools, it is not to be found in [illegible] in the supply stores. The usual method of producing a saw is to chisel it out of a piece of cast steel of the required thickness, or to [illegible] from a bar, drill the centre for an arbor, file or [illegible] the periphery, and, after truing it, file the teeth.

A better way to form the teeth is to make and [illegible] one hob of eight threads to the inch [illegible] threads to the inch, hobs made like those [illegible] thread chasers. But for forming the [illegible] the hob should be cut to a single angle tooth, [illegible] having an acute angle on one side—the [illegible] a right handed thread, the other [illegible] right angled to the axis of the hob. A [illegible] of the selection of the tooth is got from [illegible] milling tool or the circular saw [illegible]

[illegible] hob suspended between the centres [illegible] can be cut or toothed by a very [illegible]. The drilled and turned saw blank [illegible] in the ordinary [illegible] having a stud on which the blank is [illegible] by means of a nut and washer, but so that [illegible] [illegible]



NELSON'S STUDENTS' MICROSCOPE.*

OUR Figure shows a medium-size microscope, constructed by Messrs. Swift and Son, embodying some suggestions of Mr. E. M. Nelson, with special reference to histological research with high powers when only a moderate outlay is allowable.

The principal point of novelty is that the front of the stage is cut away so that the position of the substage, with the diaphragms, condenser, &c., may be readily seen from above the stage, and the diaphragms rapidly changed: also permitting the finger to be placed on the upper edge of the slide for safety in focussing with high powers. Amongst other additions, it may be noted that finders are applied on the stage by which the position of an object may be recorded without the use of mechanical movements, the graduations for the vertical movement being on the stage-plate, and those for the lateral movement on the sliding-bar carrying the object. The optical body divides in two for portability. The eyepieces are fitted with different lengths of tubing, so that the 10in. length is maintained with each from the diaphragm to the nose-piece, as with Powell and Lealand's microscopes. Mr. Nelson's centring substage with lateral swinging diaphragm-carrier is also applied.

CHEMICAL EXPERIMENTS IN THE LANTERN.*

THERE is one class of experiments which has hardly received all the attention it deserves—namely, chemical experiments performed in the lantern, an image being thrown on to the screen. Not only are such experiments attractive in themselves, but they may be put to real service in showing on a large scale many of the [illegible] which the [illegible] of photography [illegible]. [illegible]

[illegible]

[illegible]

polished surfaces of these strips should also be rubbed down to give them a ground surface which will afford them a stronger hold. The cell may then be put together by warming the glass and applying marine glue, with the aid of a heated piece of iron, —an old file, for instance, or, in the absence of anything better, than useful domestic implement, the kitchen poker. One disadvantage of marine glue, however is that the heat from the lantern, if it is in for a long time, may cause it to leak. Another good way of joining the glass, and one which requires less skill, is to cement it with bichromated gelatine and expose to light; if this plan be adopted, it is advisable to paint the cemented edges, inside and outside, with sealing-wax varnish or gold size applied with a camel-hair pencil. Gold size may itself be used to cement the glass; but, except for microscope cells, we do not care for this. A very good form of cell may be made by mixing two pieces of glass in wooden frame the size of an ordinary carrier but thicker, these two pieces of glass being separated by a piece of rubber tube, or, better still, a strip of solid rubber such as is used for [illegible] bent round to form the bottom and sides; the glass plates are placed sufficiently near together to squeeze the rubber and make a watertight [illegible]. [illegible]

[illegible]

[illegible]

a solution of some dye, such as turmeric or indigo; the effects of acids and alkalies on solutions of blue and red litmus, &c., &c. So many experiments will naturally occur to the mind of the reader that it is needless for us to enumerate more. One of the best things we have seen demonstrated in this way, though it is hardly within the province of the photographer, was the electrolysis of a substance, a solution of chloride of copper being used to which a small quantity of a solution of indigo in sulphuric acid was added. As the chlorine gas was evolved in little bubbles at the positive pole, the indigo was rapidly bleached, the experiment being rendered very striking by dividing the cells into two parts with a little roll of blotting paper, a terminal being placed in each of the two divisions of the cell.

AN IMPROVED CARRIER FOR LANTERN SLIDES.*

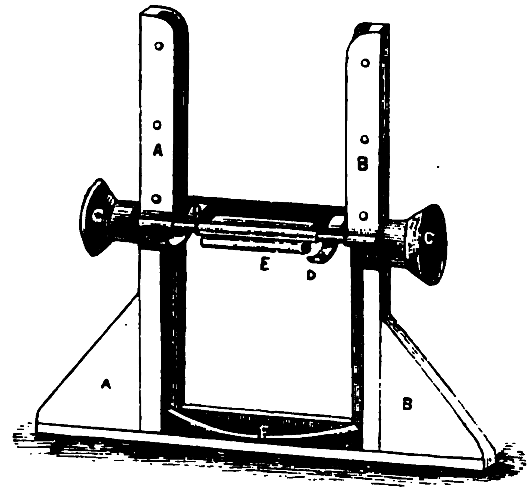
NATURE again looks frowningly upon all that pertains to the photographic art. The landscape is bare, and the camera is rarely to be seen outside the studio; the lens of which, even there, wears its cap over its eye perhaps a little too long for the professional photographer. Nevertheless we have little cause to grumble. The light of science shines even brighter in these dark December days; at least, as far as photography is concerned, we can well afford the sun its few weeks' retirement in the regions of mist and cloudland, so familiar to the Sons of "Caledonia stern and wild." But the foot-prints of the tripod are still upon the mountains' brow. Though the click of the instantaneous shutter is heard no more, there must be mental as well as photographic impressions amongst us of where we have been with the camera, and the question naturally arises, How shall we impart to our fellows a share of that pleasure which the modern appliances of our art are capable of bestowing upon all true lovers of Nature? The answer is, by means of the lantern—the optical lantern, or Sciopticon, as the modern instrument is now called, for which every photograph of interest should be produced in the form of a slide, if there is a desire on the part of the artist to see it to the best advantage.

The management of the lantern at public exhibitions does not seem to get that share of attention which ought to be bestowed upon it, and Photographic Societies should endeavour to take the lead in this direction. It is with the desire of stimulating ours to greater activity that I venture to approach you on the subject.

The lantern slide carrier may sound to some of your ears as a very unimportant part of the lantern outfit, yet to my mind it is the very back-bone of a successful entertainment. Mr. Chadwick, who has done so much to simplify lantern manipulations, has overcome, to a certain extent, the difficulty of exhibiting slides of various sizes, and we all join with him in the lament that slide-makers cannot agree as to the size most convenient for this purpose. Here is a matter to decide at the proposed International Photographic Congress at Brussels. A universal size of slide would do much to advance the interests of photography, and remove a load of anxiety from the mind of the lantern conductor. We would then be in a better position to exchange slides with other nations, and be sure of exhibiting them without any special arrangement in the form of our carriers.

Mr. Chadwick's improved carrier, as you are aware, is simple and effective enough when two lanterns are used, but for the mere purposes of exhibiting a series of photographic views there is no need of two lanterns, unless it be for the purpose of *effect*, and that is no small matter in a lantern entertainment. To see a picture come on the screen in its proper place and remain there quietly till the lecturer has passed his remarks upon it, and to pass as quietly away, is a pleasure we seldom enjoy under present circumstances. When a single lantern is used we are accustomed to see the pictures pass along the screen in regular, and sometimes irregular, succession, with an ugly streak of black between each, caused, you are aware, by the binding of the two glasses and the round or cushion-shaped mask between them. Why this has been so long the form of mounting slides is difficult to understand: it is much better to leave out the mask, and with the picture close up to the edge, bind only the top and bottom of the slide; and if the push-along process of exhibiting them be adopted, we have something more approaching a panoramic effect, and the eye will not be so painfully impressed with what in reality appears more prominent than the picture itself, namely, its mask and binding. This, with the single lantern, will be found a practical way of getting over the difficulty when slides of various sizes are to be exhibited; indeed there need be no limit to the length of the landscape slide, though for portraits the mask is indispensable. A universal size of slide, after all, would be the most acceptable.

Fig. 1.



I shall now describe my carrier and the mode of using it. The only difficulty in the way of its being immediately adopted is that a special arrangement is necessary to be made with that part of the lantern which bears the lens. The improved Sciopticon requires no alteration except in the hood which shades the light between the condenser and the objective. After seeing the carrier at work, you will find it requires no great amount of mechanical skill to effect the desired alteration, and to introduce what I venture to hope you will consider an important improvement in lantern slides carriers. The following sketch will give some idea of the shape and mechanical arrangement of the carrier in its improved form

A A and B B Fig. 1 is the frame, which may be made of either wood or metal. C C is a spindle which passes from side to side of the frame, terminating at each end with a suitable thumb-screw, by which it is turned in the act of changing the slide. D D are two metal plates passed through the above spindle, which act as levers in pushing away the slide. E may be called a self-acting balance lever, the form and action of which will be better seen in Fig 2. F is a spring to counteract the force of the falling slide, upon which the successful working of the carrier much depends, in adjusting which be careful to give it a slight turn inwards, so that the slide on falling may not be forced outwards. Fig. 2 is a full-size section of the principal part of the carrier as seen from the side. A is the spindle; B the self-acting balance lever, which is simply a plate of metal bent round the spindle in the form represented, the round black part of which is filled with lead, thus causing the lever to press against the slide C, and hold it in position till forced away by the spindle levers in the act of changing the slide.

In using the carrier drop a slide in at the top of the frame at A and B, Fig. 1, till it rests on the spring F. That being exhibited on the screen, drop another slide in at the top as before, while the spindle levers are lying in a horizontal position, thus preventing the top slide from coming in contact with the bottom one. The lecturer having finished his description of the view on the screen, gives the signal, while you give the thumb-screw C a slight turn, and, in a flash, the scene is changed.

If I have made the description plain enough, you will perceive the slide on being expelled from the carrier falls forward upon a cushion or pad, from which it is removed during the description of the succeeding slide, and so on till the close of the lecture.

I ought to say that to some the idea of exposing the slides in this way is not new. My carrier, in its original form, was shown to some of the members of this society five years ago. Since then there was something similar spoken of in the journals, though I have sought in vain for a description. This, and the desire to introduce an improvement in our lantern exhibitions, is the only apology I have to make in bringing before you a lantern innovation.

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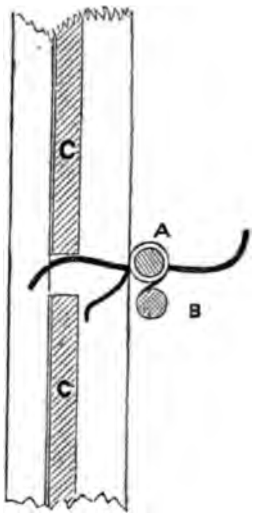
[*] By J. McKean. A paper read before the Edinburgh Photographic Society.

A free railway exists in Oakland, California, a town on the opposite side of the bay from San Francisco. The Central Pacific Company desired to pass through it, and the principal street offered the best route; but the people of Oakland only consented on condition that they should have free passage over this section of the line, which is the case, no fares being demanded.

Fig. 2.



SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE January meeting was held at the Society's Rooms at Burlington House on Friday, the 11th inst.; Mr. W. H. M. Christie, Astronomer Royal, in the chair.

William Henry Davies, 55, Great Newton-street, Liverpool; Edward H. Nightingale, M.A., 3, Park-row, Albert-gate, S.W.; Cuthbert E. Peek, B.A., Wimbledon House, Wimbledon; and the Rev. W. H. K. Soames, M.A., Chesterton-road, Cambridge, were duly elected Fellows of the Society.

Mr. Glaisher read a paper by Mr. Pratt, of Brighton, on "The Belts of Saturn." He had observed the narrow belt described by Mr. Ranyard at the last meeting on several occasions since October, and believed that it was not a new feature. The paper was accompanied by a photograph of a drawing of Saturn made in September, 1874, in which a similar belt in the northern hemisphere of Saturn was shown. Mr. Pratt described the belt in the southern hemisphere, which he identified as corresponding to Mr. Ranyard's belt as of a Vandyke brown colour, consisting of a string of small clouds situated in latitude about 10° south. He had observed a similar belt there for some time.

Mr. Ranyard said: Since the last meeting I have heard from Mr. Denning, who has kindly sent me a drawing of Saturn, showing a narrow belt similar to the one I described at the last meeting. Like Mr. Pratt, he seems to have seen it last year. He agrees with me in placing it in latitute about 15° or 20° south, and makes it also adjacent to the southern cloud-cap. Mr. Denning has seen this belt within the last few days. I find, also, that Mr. Ward, of Belfast, has seen a similar belt, so that there can be little doubt about its existence. I have not seen it broken up into a string of clouds, as it is drawn by Mr. Pratt; but I suspected loops or notches on the edge of the belt, something like the loops or notches seen on the belts of Jupiter, but not so distinct: these were smaller notches. Mr. Green tells me that he has seen these notches, and has no doubt about them. It appeared to me that the belt was a bluish-brown, rather than a reddish-brown, but I do not attach much importance to estimates of such faint tints.

Lieut.-Colonel Herschel: There can be no doubt about the existence of this belt. My brother tells me that he has seen it, and that his daughter, who is a child of only 12 or 14 years of age, saw it when it was pointed out to her.

Mr. Knobel: The belt drawn by Mr. Pratt is almost identical with the belt or string of clouds shown by Trouvelot in his well-known drawing published in the *Proceedings* of the American Academy.

Captain Noble: If I understand rightly, Mr. Pratt's belt, which is in the northern hemisphere, would now be almost in contact with, or hidden by, the ring. Its edge might, perhaps, just be seen above the crape-ring, where it crosses the planet. We are looking now at the other side of the ring from that shown in Mr. Pratt's drawing made in 1874. I have seen, in contact with the ring this year, something which I took to be the shadow of the ring on the planet, but I find that the shadow could not have been seen from the Earth at the time, so I think that it may have been Mr. Pratt's northern belt, or possibly Mr. Ranyard's belt, though I think that would have been higher up.

Mr. Green made a drawing on the blackboard to illustrate the appearances he had seen on the ball

SCIENTIFIC NEWS.

OBSERVATIONS of Comet Pons-Brooks, as it is now called, have been made in nearly all parts from which intelligence has been received, and sufficient data have no doubt been obtained to determine the period with almost complete accuracy. In the *Comptes Rendus* of the 31st ult., M. Perrotin, of Nice, gives a record of his observations up to the 24th of December, when the nucleus of the comet was equal in brightness to a star of the 5th magnitude. A tail nearly two degrees long was visible to the naked eye, and was surrounded by a nebulosity about 7′ in diameter. M. Trépied, at Algiers, has examined the comet with the spectroscope, and found the spectrum to consist of two bands in the green of different degrees of brilliancy, the more refrangible having a greater degree of brilliancy than the other; a third band, very faint, was seen in the blue. He finds these bands to be practically identical with those found in the spectrum of an alcohol flame.

M. Cornu, the distinguished French physicist, has communicated to the Academy of Sciences, Paris, a note of his observations of the rare phenomenon of a white rainbow, or Cercle d'Ulloa. The phenomenon was observed between nine and ten, the sun having risen in the midst of level banks of cloud. A thick hoar frost covered the ground, and a light fog thinly veiled the sky, which, however, was clear towards the zenith. Opposite the sun there appeared a great white arc or rainbow, without a trace of colour. M. Cornu gives the apparent altitude of the highest part of the bow as 23° 26′; the apparent span 80°, while the height of the sun was about 17° 24′. He compares the appearance to that of smoke rings made with phosphoretted hydrogen.

Mr. Latimer Clark has issued (Spons) a little manual of the Transit Instrument as used for obtaining correct time, which, with his tables, and the instrument itself, will enable any one to obtain absolutely correct time with a less error than one second.

No. 25 of the *Mineralogical Magazine* contains a paper by W. H. Hudleston, M.A., the president, on a recent hypothesis with respect to the Diamond Rock of South Africa; another by Mr. J. H. Collins, on the "Minerals of the Rio Tinto Mines," the bulk of the part being, however, taken up by Prof. Heddle's continuation of the "Geognosy of Scotland."

At a recent meeting of the Glasgow Philosophical Society, Sir W. Thomson read a paper on "Measurement of Electric Currents and Potential," in which he spoke of the importance to practical electricians of such instruments, and stated that at the Vienna Exhibition he had been greatly impressed by the want of instruments to give definite and accurate measurements. He does not think this want will long remain unfilled, and proceeded to explain two instruments of his own invention—viz., a graded current meter and a graded potential meter. In future he will express the rate of conductivity in "mhos," a term which he thinks will be useful in describing the reciprocal of ohms.

A series of experiments on the effect of various gases in reducing metals from solutions has been made by Dr. G. Gore, F.R.S. He thinks the process for reducing metals might be useful in physical experiments, and believes that the metals found in the fissure veins of the earth's crust may have been produced by the gaseous hydrocarbons derived from organic sources.

The thirty-seventh annual general meeting of the Institution of Mechanical Engineers will be held on Thursday, the 24th, and Friday, the 25th, at 25, Great George-street, Westminster.

According to the Patent Office rules, drawings are to be prepared on Imperial paper, within a border line of 27in. by 19in., or 19in. by 12in., leaving a margin of ½in. all round. Unless some mistake has been made with reference to the margin, the paper will have to be trimmed, for whole sheets of Imperial drawing paper are 30in. by 22in, and half-sheets are therefore 22in. by 15in., which it will be seen leave a margin of 1½in.

Another matter connected with the Patent Office and the new Act is that notwithstanding the clear provisions of section 45, subsection 3, the Office refuses to accept renewal fees by instalments on patents granted prior to the commencement of the Act, or at least on those for which the fees of £50 and £100 have become payable recently.

A salesman in Covent Garden market recently advertised for a few pounds of ripe strawberries, stating that he had a special order, and could get £5 per pound!

M. Debray has communicated to the Academy of Sciences some new facts relating to the liquefaction of nitrogen. Oxygen has been liquefied by high pressure, and when that is suddenly withdrawn the lowering of the temperature is so great that crystals of solid oxygen appear, and nitrogen in contact with liquid oxygen becomes liquid too.

A conversazione was held at the Public Hall, Harrow-on-the Hill, on the evenings of the 9th and 10th inst, under the auspices of the Young Men's Society of the town. Some interesting examples of railway signalling were shown by one of the heads of departments in the L. and N. W. Railway; Mr. St. John Gunn exhibited some experiments in electricity; and a good collection of model engines, kindly lent by Mr. R. A. Lee, of 76, High Holborn, attracted considerable attention.

The Prince's Theatre in Coventry-street, which is opened to-day, has been fitted with arrangements for electric lighting by Messrs. Strode and Co., of Osnaburgh-street. The auditorium will be lit by four electroliers of twenty lights, each suspended from ceiling to the different tiers by electric brackets and pendants. The foyers, grand stairs, corridors, &c., and also the float light for the stage, are fitted with the electric light. The current will be generated by one of Siemens's S. D. dynamo machines, driven by a 12 h.p. gas engine, the current being stored by a Faure-Sellon-Volckmar accumulator of 55 cells. The lights are all ingeniously fitted for gas as well as the electric light, in case of casual failure of the latter.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 81, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE LATE J. H. DALLMEYER—"RECONCILIATION" AND RUBBISH—RECENT SUNSETS—THE LIGHT OF OTHER DAYS—THEORY OF THE SUN'S MOTION—THERMOMETER BOX—FLUORESCENCE.

[22236.]—IT was with most sincere regret that I observed the announcement of the death of one of the most scientific opticians in England—I mean Mr. J. H. Dallmeyer—at the comparatively early age of 53. Few men combined the amount of mathematical knowledge that he possessed, with his intimate practical acquaintance with the mechanical operations of his profession. As thoroughly familiar with theoretical optics as he was with practical lens grinding, he had at once the mind to conceive and the mechanical skill to produce instruments which his untimely death will now render more precious than ever. I remember, when I was a very young man, the late Andrew Ross saying to me, in speaking of Dallmeyer, "Sir, if he lives, he will be the first object-glass maker England has yet seen." There are many who will think that he did survive long enough to justify this prediction of his great forerunner. Great as were his attainments, no more modest and unassuming a man ever lived, and the loss of John Henry Dallmeyer is emphatically one to practical science.

I was very sorry, too, although in a different way, and for a totally different reason, to see that Dr. Kinns (who is, I am afraid, a Fellow of the Royal Astronomical Society—albeit he was "declined with thanks" at the Geological) had been attempting, in a lecture in the library of Canterbury Cathedral, to show that the first two or three chapters of Genesis are *scientifically* accurate. I have, for my sins, waded through Dr. Kinns's book ("Moses and Geology") upon this subject, and a more wonderful hash of authorities, from the worthiest to the most worthless, and astonishing muddle of their conclusions, I never came across. The mischief done by these pseudo-"reconciliations" is incalculable. Ignorant people accept them *pro tempore;* but finding out their rottenness with increasing knowledge, arrive, in a large proportion of cases, at the fallacious conclusion that, because such attempts to show that Genesis narrates physical facts are all rubbish, everything narrated in the mass of writings of which that book forms the exordium, must be equally valueless. It is men like Dr. Kinns who furnish the Atheist and the Freethinker with his most powerful weapons: enabling him to say to the frequenters of "Halls of Science" and the like: "If a theological system requires bolstering up by such easily-refuted nonsense as this, what sane man need waste any time on it?" It would be utterly contemptible, were it not pitiable, to see a Kinns getting up and talking about all the theories of evolution being swept aside, at a time when the grave has only just closed over Darwin! Verily this affords a saddening example of the manner in which Religion is wounded in the house of her friends. (Since writing these lines I have seen Mr. Carruthers's crushing attack on Dr. Kinns's rubbish in a morning newspaper. It is as true as it is pungent. I could hardly give it higher praise.)

The ideas of "B. R." (letter 22194, p. 384) appear to be—if he will forgive me for saying so—just the least thought vague. The peculiarity in the recent sunsets really consisted, not in the depth of their colouring, gorgeous as that was, but in the appearance and persistence of the crimson afterglow long after the sun had descended below the horizon. "B. R.'s" notion that anyone has tried to associate the ordinary red, orange, greenish, and steel-blue hues of sunset with meteoric dust is a fallacious one. What has been contended, with a very considerable show of reason, is that impalpable meteoric dust at a great altitude would reflect the red light produced by the passage of the sun's rays through vapour-laden air after the sun was at a considerable distance beneath the horizon. In our ordinary sunsets the warm colours are chiefly produced by transmitted light, the cold ones by reflected light, and the neutral tints by both combined. So much for your correspondent's concluding paragraph. With reference to his first one, meteoric dust in greater or less quantities is always suspended in the air; but it is, as I have just previously intimated, in the form of an impalpable powder. It is brought down by every shower of rain; but, of course, this does not entangle it and preserve it for examination as snow does. It does not become incandescent, because it offers little or no resistance to the air. In the case of shooting stars, they may weigh from half an ounce upwards, and entering our atmosphere with a velocity of between 20 and 30 miles a second, are dissipated into vapour by the mere friction. Doubtless, we derive our main supply of meteoric dust from this very source, although it may also exist in space in an impalpable form too.

"J. H. C." (letter 22202, p. 386) has only to carry out his conception a little further, and imagine himself to be travelling away from the Earth at a sufficient rate of speed, to see how all terrestrial occurrences would be inverted. Trains would seem to leave their destination and arrive at their starting places, balls travel into the muzzles of guns, men regrade from old age to infancy, and so on.

It is not very easy to answer a query put in the form of 52592 (p. 395); but, perhaps, it may help "P." to understand what the President of the Royal Astronomical Society meant by the words he quotes, if he will reflect, that in the Solar theory we adopt a certain mean motion of the Sun in longitude, which we call a Mean Solar Day. It is, however, quite evident that every time we change our adopted value of the Sun's mean motion we change the length of our adopted day. I am expressing no opinion here as to whether Mr. Stone's idea is a correct one or not; I am simply trying to put it into slightly different words. His conclusions are endorsed by that most eminent geodesist and astronomer, General Tennant; while Professors Adams and Cayley contend that while *a* change in the unit of mean solar time must result from the substitution of Le Verrier's tables for Bessel's formula, such change only amounts to the $\frac{1}{385}$th part of that which is alleged to have taken place by the Radcliffe Observer.* I must, though, caution "P." that the whole discussion is of a highly technical character, and one which scarcely admits of being put in a popular form.

I grieve to say that "Agricultor" pays me wholly undeserved compliment in query 52606 (395) in his supposition that I use "a properly-co structed box" for my thermometers; if by be means one of the orthodox thermometer stands, with louvres, &c. My wooden thermometer frame is placed against the north wall of my observatory, with a slight interval between them to enable the air to circulate. It has a deep pent-roof and wings at the ends, so that the sun can never shine on the instruments, even at the end of June. Otherwise, the frame is freely open to the north. Doubtless, though, many of our more essentially meteorological brother-readers will give him a description of the stand now so generally employed.

Mr. Harcourt (query [illegible], p. [illegible]) should get some fresh seeds of the thorn-apple (Datura stramonium), and pour over them rather more strong spirits of wine than will suffice to cover them, letting them macerate in this for some time. Paper written on with this tincture shows the writing most beautifully phosphorescent in the violet and ultra-violet rays of the spectrum. I have often experimented on this by projecting a spectrum from an ordinary prism on to paper prepared in this way, without even darkening the room; but of course, the effect is more striking if the experiment be performed in a dark chamber. Or, if the room be darkened, and only rays passing through deep blue or violet glass be suffered to enter it, the writing shines brightly out under such illumination. Has your correspondent ever tried an infusion of horse-chestnut bark, made by pouring hot water over it? This solution is yellow by transmitted light, but of a beautiful blue by the violet rays which it disperses. Red sanders wood, too, if infused for some time, yields a slightly-coloured solution. To this we must add a little liquid ammonia, and it will then look brownish by transmitted light, and a strong blue by that dispersed.

A Fellow of the Royal Astronomical Society.

COMPANIONS OF SIRIUS—CASTOR A—D.

[illegible].—Certain minute companions to Sirius have been suspected on more than one occasion, but the evidence of their actual existence is not very strong. The accompanying diagram and brief account of these objects may, however, be of some use to those desirous of searching for these minute points of light. The recognised *comites* are three in number, and are lettered B, C, and D in the diagram, where their approximate positions are given for 1884·0; a cross shows the place of Sirius in 1862·0, the irregularities in the p.m. being of course neglected. B, the well-known companion, was discovered by Mr. Alvan G. Clark, on January 31st, 1862, and is the only one at present known to be physically connected with Sirius. It is not a difficult object with a moderate aperture, provided the air is steady, and has been seen in these latitudes with a 5in. refractor. It has been suspected of variability, but probably without sufficient reason. It is now rapidly approaching its primary, and in a few years will scarcely be visible with the largest telescopes, the calculated distance in 1890·1 being only [illegible]. C was discovered by Marth, with Mr. Lassell's 4ft. reflector at Malta, 1865, January [illegible]. The following are the principal measures of this star:—

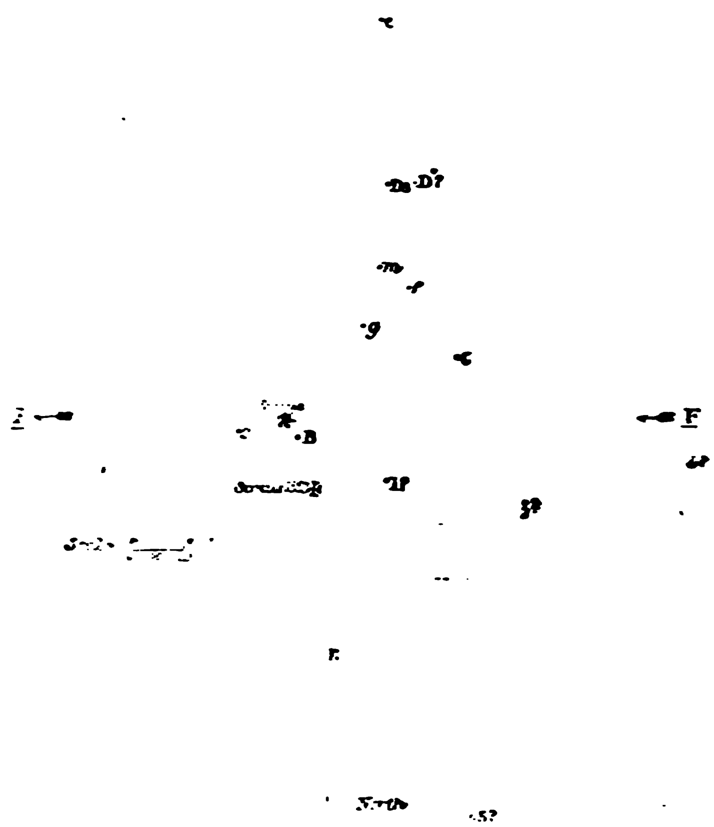
	°	″	
Marth	[illegible]	—	1865·[illegible] ([illegible]).
Hal	[illegible]	[illegible]	1877·[illegible] ([illegible]).
[illegible]	[illegible]	[illegible]	1877·[illegible] ([illegible]).
[illegible]	[illegible]	[illegible]	1878·21 ([illegible]).

Hal. rates it about 13 mag. in S.'s scale. Dr. Wentworth Erck has seen it with his 7in. Clark. D is one of Goldschmidt's companions (No. 3), and is an easy object with 6in. aperture. For this we have—

	°	″	
Marth	[illegible]	[illegible] —	1865·[illegible] ([illegible]).
Se.	[illegible]	[illegible]	1865·[illegible] ([illegible]).
MacGeorge	[illegible]	[illegible]	187[illegible] ([illegible]).
[illegible]	[illegible]	[illegible]	187[illegible] ([illegible]).
[illegible]	[illegible]	[illegible]	187[illegible] ([illegible]).
[illegible]	[illegible]	[illegible]	188[illegible] ([illegible]).

Se.'s measure is printed [illegible] in the second series of measures, and has been supposed to refer to some companion seen only on the occasion of his measure; but I have very little doubt that it should be as given above. The changes in C and D are due, of course, to the p.m. of Sirius.

Shortly after Alvan Clark's discovery, Goldschmidt announced, in a letter to Prof. Peters, that he had succeeded in detecting six new stars near Sirius, only one of which (his No. 3, D.) has ever been recognised by any other observer since. His account of his observations will be found in *Comptes Rendus* LVI., p. [illegible]; *Ast. Nach.*, Vol. LX.; *Monthly Notices* XXIII., pp. [illegible], 243, &c. The note on p. [illegible] of Vol. XXIII. of the *Monthly Notices* is said to be "translated, and the woodcut extracted from No. [illegible] of *Les Mondes* (the weekly scientific journal edited, in place of the *Cosmos*, by M. l'Abbé Moigno)"; and the woodcut given in Vol. I. of the *Astron. Register*, p. [illegible], is also said to have been copied from the same publication. I have been unable to find any woodcut in *Les Mondes*, or any allusion to Goldschmidt's observations other than the note on page 130, and the *Cosmos* likewise only has the excerpt from the *Comptes Rendus*. As there are some slight differences between the two woodcuts in the *Notices* and *Register*, I have preferred to employ that given in the latter publication; and for the details of the observations I have used Goldschmidt's communication in the *Comptes Rendus*, the translation on page 131 of Vol. XXIII. of the *Notices*, and Goldschmidt's letter on p. 243 of the same volume. Some of the details of the observations are rather difficult of comprehension, probably owing to typographical errors. Goldschmidt expresses his astonishment on finding that Clark's *comes*, which he was able to see at intervals with the telescope he used (a 4·2in. refractor) was not the only one, and that there were several others in the immediate neighbourhood of Sirius, at distances varying from 15″ to 1′ of arc. He says, "Mes moyens restreints d'observation ne me permettaient pas de mesurer les distances de ces points lumineux immergés dans l'éblouissante lumière de Sirius," but that No. 1, "sans aucune doute un compagnon," is situated to the south of Clark's *comes* and has a position angle of 95°–97°. It is visible at intervals, and appears a little farther off than A. C.'s. (Goldschmidt assigns both letters and numbers to the stars in his communication in the *Comptes Rendus*: but I have omitted the letters, as they differ from those given in the diagram in *Monthly Notices*, and if retained would only cause confusion). No. 2 is an almost imperceptible point, situated on a line drawn through Sirius and Clark's comes. No. 3 (D) is to the east of Sirius and No. 1, on the same parallel as the latter, distance from Sirius 3·60s. to 3·80s. in R.A. No. 4 has a position angle of 170° [?], and No. 5 of 25° to 30°, "et sont distantes de Sirius par rapport au compagnon No. 1." There is also a star about 10″ to the east of No. 3 D; this I have marked D. One thing is pretty evident from Goldschmidt's description and drawing, and that is, that he has greatly underestimated the distances of the stars seen, or supposed to have been seen, by him. The stars are arranged by him in order of distance, and, as all the companions are said to be within 1′, No. 3 (D) would seem to be about 45″ or 50″ from Sirius: the actual distance in 1865 being about 119″. I have placed Goldschmidt's stars in about the positions they would seem to occupy from his description and diagram, but as the places are naturally very vague, I have added a "?" to the Nos. No. 2 is said to be in a line with Sirius and Clark's *comes*, and the pos. angle should therefore have been about 85° ± in 1862, but the position of Clark's star and No. 2 in both the diagram in the *Monthly Notices* and that in the *Register* is nearer 55°. If my surmise as to the distance of Goldschmidt's companions is correct, it is easy to see why Nos. 2, 4, and 5 have been overlooked by later observers; at the same time I am very far from saying that I believe in the actual existence of any such stars. It is not generally known that Goldschmidt found two close companions (of which he gives a diagram) to Procyon, "si près de Procyon," he says, "que l'on peut à peine les voir séparées ou détachées de la grande"; but I should be very much inclined to put these at least down to an optical illusion. We know, from the case of γ Libræ, for instance, that Goldschmidt largely underestimated the distance of faint companions, and in the case of very minute points near the overpowering blaze of Sirius, the natural tendency to do so would be greatly increased. The only other observations of faint stars near Sirius which demand investigation are those of the observers with the Melbourne reflector. They will be found in the *Transactions* of the Royal Society of Victoria, X. pp. 69, 70, and 128—130. Eight diagrams are given; but the observations are not of a very satisfactory character. The star β is placed from the sketches of December 23rd, 1869, February 2nd, 1871, and February 23rd, 1872. Its actual existence seems more than doubtful; but I have assumed that its p.m. is the same as that of Sirius. ε, the most distant, was first seen by Mr. MacGeorge (who made nearly all the observations) on December 9th, 1870, and on several subsequent occasions since; ζ and [illegible] were seen on Feby. 2nd, 3rd, and 4th, 1871, and Feby. 23rd, 1872; α apparently only on Feby. 23rd, 1872, K, which is called a "group," on Feby. 2nd and 3rd, 1871, and Feby. 23rd, 1872. They do not appear to have been seen in the great American refractors, or with Lassell's reflectors.

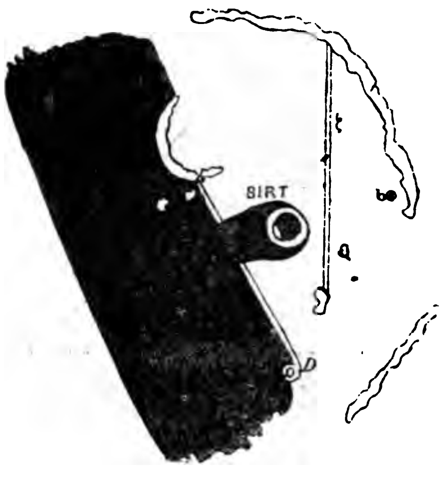


Castor A—D. In the ENGLISH MECHANIC for July 14th, 1882, p. 426, I referred to a very distant companion to Castor measured by H. and So., the distance being 197·114″ (misprinted 177·114″ in my letter No. [illegible]). I have recently found that there is a curious error in the distance of this star in H. and So. The distance is entered on p. 107 of their work, and in other places where it is quoted, as 3′ 17·114″. The actual value is 3′ 37·114″—i.e., that corresponding to 902·98 parts of the micrometer of the 7ft. equatorial. The measure, therefore, stands 224·25° : 217·114″ : 1823·12 (1 night). The date of the second measure of the angle of A—C is given in H. and So. as 1822, Feby. 19th; it should be, as I find on consulting the original MSS., 1823, Feby. 19th. It is well known that C probably forms a ternary system with Castor; it is very unlikely that D is also physically connected, but it is desirable that its present angle and distance should be put on record.

Jany. 7th, 1884. **H. S.**

SELENOGRAPHICAL—BIRT—MESSALA —HORBOX.

[illegible].—In the *Astronomical Register* for December, Mr. Gwyn Elger mentions the clefts [illegible] and [illegible] east of Birt, the former of which is a tolerably easy object, while the latter is very rarely to be seen. He relates the only recent records of its existence which he has met with. I was fortunate enough to see it on Nov. 24, 1880, when it and [illegible] appeared as one continuous cleft, which commenced on the north at the hill shown by Mr. Neison, and passed Birt at a little distance instead of bending up to its wall as on Mr. Neison's map, and sloping somewhat to the east, it extended quite up to the ridges which almost inclose Birt and Straight Wall on the east and south. This is the only occasion on which I have seen both clefts, but ϕ has been visible at other times, on one of which I thought it passed through this hill, though I could not trace it beyond. I send my sketch of Nov. 24, 1880. Two



of the row of hills between Straight Wall and Thebit are visible on it.

May I take this opportunity of telling Mr. Elger also with regard to the semicircular ridge on the floor of Messala mentioned by him in the *Astro. Register* for November, that in Dec., 1881, there was a corresponding semicircular ridge outside the wall of Messala, the two forming a complete shallow ring divided in half by the wall? I am supposing that the ridge seen by him is that half of the ring which is within Messala on its floor. I have a sketch, but perhaps this description is sufficient.

On Jan. 6, at 11h. 45m., I was able when the clouds broke to obtain a few glimpses and a sketch of the crater in Horrox. The mist never wholly cleared away, and the moon was getting rather low, so that vision was not very good, but I plainly saw in the position Mr. Gaudibert indicates a good-sized circular black spot, which, whatever it really is, had the appearance of being a deep black hole. It strongly reminded me of Hyginus N. There was a very little shadow under the south-west wall of Horrox, from which the spot was quite separated. Whether it was also separated from the wall nearest to it, or whether it extended into shadow there, I could not distinguish; neither could I distinguish the ridges on the floor of Horrox. On Jan. 7, at 6 p.m., I made another sketch. The spot was still visible, but was less black and rather elongated southward towards the ridge, the shadow of which it joined. Both ridges were visible.

On both nights, and especially Jan. 7, the spot was a very conspicuous object. **M.A.**

AFTERGLOW—JUPITER—SATURN—MARS.

[22239.]—I HAVE seen no mention of one fact with regard to the remarkable light and colour lately seen in the sky. During the continuous cloudy and foggy weather of which we have now had so much, there has often been a strong rose-coloured glow upon the clouds in the W. and N.W., extending half-way to the zenith, and visible as late as 6 and 7 o'clock. On the 2nd of January it was remarkably strong, and had it not been for its perfect steadiness, one would have set it down at ence to be an aurora. A slight rain was falling at the time. I have repeatedly discerned it during the last few weeks, more or less strongly visible. Seen like this on a cloudy sky, it surely must be an atmospheric effect, and not due to meteors. Is the aurora ever seen as a perfectly steady glow, projected on an entirely cloudy sky? The delicate sea-green colour which has been seen in the sunset effects recently, and which has been mentioned as unusual, has been noticed by me sometimes in remarkably beautiful sunrises for many years past. It is rare, but far more rare at sunset than at sunrise. I have remarked it more often in the sunrises of autumn than any others. It generally appears as a narrow band of clear sky bordered above, and sometimes below also, by dark clouds. It is one of the most delicate tints that it is possible to see.

With regard to Jupiter and Saturn, the points I have noticed are that the definition of Saturn and the outline of the ball and rings is always much sharper and more distinct than the definition of Jupiter, the latter appearing soft and woolly at the edge, giving one the idea of looking at a thick atmosphere. Secondly, that Saturn bears a higher power than Jupiter, which is very noticeable. This follows naturally, I should suppose, from its sharper outline and definition. Thirdly, that fine mist of a certain kind improves the definition of the belts of Jupiter by diminishing the glare.

The difference in colour of the ball of Saturn and the rings is always striking with anything like a good night, the ball being almost a deep yellow and the rings a pearly white. The difference in colour of the outer and inner ring is always to be seen also, the inner being the whitest and the outer more dusky with a somewhat stratified appearance, as if composed of numerous narrow rings. The outline of Mars is never sharp to me, and it is the most difficult of the three to observe; but this is probably partly due to the fact that it requires a larger telescope than the other two planets. One other atmospheric point I have noticed during the last two or three months: that the temperature has varied so rapidly and so greatly, sometimes as much as 10° in one night—e.g., on Dec. 17 up to midnight, it was 30°, and by 3 a.m. it had reached 40°. For more than a week now the temperature, even through the night, has been 50° and higher, quite as mild as many summer nights. I do not remember so high a temperature as this through the night at this time of year ever before. **M. A.**

[22240.]—WHILST discussing the very curious phenomenon of the chromatic sunsets which have engaged the attention of our correspondents for the past month, nobody seems to have noticed how strangely non-actinic the light has become. Mine is but amateur experience; yet on trying photography I found twice the time required which I would judge necessary to insure an image under normal circumstances at this season of year, and on mentioning the matter to a professional I found my experience coincides with his. Viewing those sunsets and sunrises through a rainband spectroscope-we are struck with the prominence of those lines (telluric) which indicate aqueous vapour in the atmosphere. Possibly we shall have another wet, stormy, and cold year, which in this country causes infertility in the soil and want in the harvest.

E. B. Fennessy.

THE PLANETOIDAL RING.

[22241.]—THE contributor of the excellent article on the Progress of Astronomy throughout the Year (page 375) appears to have a great contempt for the study of the Planetoidal ring, with the exception of those few planetoids which may be utilised in the calculation of the solar parallax. From this view I venture to differ. It certainly would be unsatisfactory not to have an approximate knowledge of the scale on which the solar system is formed; but this we already possess. The ratios of the various planetary distances to that of the earth are indeed needed to the greatest possible accuracy, as the basis of the perturbational theory; but the doubtful correction to the extent, perhaps, of one-twentieth of a second of the solar parallax at a great expenditure of time and money, is to be deprecated if astronomical labour is to be saved rather than the expenditure of the same upon the Cis-Jovian The *Berliner Jahrbuch* recommends strict attention not merely to the asteroids which approach the earth, but also, besides others, to those such as Hilda, Ismene, Hecuba, Gerda, Urda, Sibylla, &c., which approach Jupiter nearly.

The latter group has been sometimes proposed as useful for determining with great accuracy the mass of Jupiter; but this would only be required for the more accurate calculation of perturbations, and this brings me to the main point I have in view, which is that the ring merits more attention—on its own account, and not as subsidiary to any other body in the system—than anything else in the solar system of the three classes of bodies, major planets, planetoids, and comets. As a test of the theory of gravity and a means of discovery of residual phenomena, the planetoids are incomparably the best. This arises from the circumstance that the perturbations of most of them are greater than those even of Saturn; in fact, those planetoids which come very near to Jupiter are disturbed by that body almost as much as are the comets, and then, owing to the extreme smallness of their disc, they can be observed with much greater accuracy than the major planets, not to speak of the comets. This is a point of great importance. The late astronomer, Le Verrier, suggested that the discrepancies between his theory of Jupiter and Saturn and observations, might be owing to the sensible discs of those bodies.

It may be said that the theory of gravity requires no further confirmation; but is it not, *à priori*, improbable that the exact law should be so simple as we suppose? In most, if not all cases, such simple expressions as at first seem to satisfy a series of facts, are found, upon a more profound study, and the observation of fresh facts, to be but a first approximation to the law. Are we sure, for instance, that the law of attraction is that it is proportional to the product of the masses of the attracting and attracted bodies (I am not speaking simply of the acceleration).

An attempt has been made to explain the existence and phenomena of comet's tails by the hypothesis that the sun acts very differently upon different kinds of matter, which is really only another way of saying that the action between two bodies is not proportional to their masses, or that the law of gravity is not always true—in some cases, not even a first approximation.

Personally, I do not think this explanation of cometic tails will hold water; but that is another question.

We may say that the law appears to hold so far as the sun and major planets are concerned, taking into account their mutual actions. But many of the planetoids would be an infinitely severer test. We have further considerations connected with the past and future, or evolution, of the solar system, on which a profound study of the ring seems likely to throw a great light. It appears probable that all the planets, and most, if not all of the satellites, were in their embryonic stage a ring of fragments.

We can no longer conclude the planetary interspaces to be a vacuum, were it only for the meteoric dust.

Now, in consequence of the smallness of their size, consequently of their masses and discs, the effect of a medium may be demonstrated upon the planetoids, when it would be utterly impossible as regards the major planets, although from such a determination we may be able to see the effect upon the major planets during a very long time.

Further, it would seem to me, at least, a matter of great interest, by a comparison of calculation and observation, to ascertain the fact of collision between the visible planetoids and the smaller. Such determinations would require the exhibition of the absolute perturbations of most, if not all, the asteroids, which, with present methods, would be a very great labour. But the aiming at this ideal might tend to improve the method very materially hitherto employed.

Whatever may be the direct utility of determination of the solar parallax by means of observations of some of the minor planets, or of the transits of Venus, indirectly they are, no doubt, the means of introducing great improvements in our instrumental appliances, which is in itself no small advantage.

It was, I believe, the opinion of Le Verrier that no nearer approximation to the solar parallax than we now possess could be attained with any degree of certainty, except, in the course of time, by means of gravitational method, which, again, would require, to be certain, a profound examination of the nature of the residual phenomena which may exist after the elimination of the action of the ordinary law of gravity as hitherto postulated.

I have read that the second opposition of Hilda has been observed towards the end of 1879, but without details. Perhaps some of your correspondents may be able to say whether this is true, and how many oppositions have been observed, if any, since that period. **W. C. E.**

ELECTRIC MOTOR FOR LAUNCH MODEL.

[22242.]—THE "Electric Motor for Model Launch" (see letter 22200) is one of M. Trouvé's, consisting of a simple Siemens armature revolving between the prolonged poles of another electro-magnet; section looks something like small capital I pivoted in its centre in the upper part of a large U. The poles of the armature are reversed every half-revolution by a commutator on its spindle, so that both parts are always being attracted or repelled from both poles of the magnet cell. The current passes round the magnet and through the armature; the battery is a bichromate of potash. For full description see page 16 of Dary's "La Navigation Electrique," published by Baudry, 15 Rue des Saints Pères, Paris, price about 1s. 6d.; or page 107 Urquhart's "Electro-Motors." Du Moncel and Geraldy's "L'Electricité comme Force Motrice" and Hospitalier's book also contain interesting accounts. All these works may be consulted freely at the Patent Office Library, Southampton-buildings, Holborn; but if desired, I will go into detail on a future occasion.

Horloger.

[22243.]—"A BIG BAIRN" (letter 22200, p. 385) asked for information which, without being a captious critic, I beg leave to say letter 22231, p. 410, does not afford. "A Big Bairn" correctly described what he saw: a model boat, with a battery aboard, and fitted with an electro-motor. If he will turn to issue of Jan. 7, 1881, p. 415, he will find a full description of the motor (Trouvé's), and an illustration, showing it in position, as in the model in question, which I have seen some dozens of times. There would be very little difficulty in making a motor like this, and the cost would be trifling. There is also further information on this motor on p. 479, Jan. 21, 1881; also in the "Development of the Pacinotti Ring," fully illustrated at p. 51, March 25, same year. For practical information about the fitting of armature, see p. 41 of present volume. New readers of the "E. M.

[illegible]

R. W. [illegible]

DYNAMOS AND ADVERTISEMENTS IN [illegible]

[illegible]

S. Bottone.

ELECTRIC ALARMS.

[illegible]

Chas Usher.

NEGATIVE PLATES FOR BATTERY.

[illegible]

[illegible]

David Gilmore.

A HAND-WARMER FOR PIANISTS.

[illegible]

W. H. Davies.

KEY CHARACTERISTICS IN MUSIC.

[22248.]—N. E. Child (22225) is wrong. The [illegible] harmonium is a patent article. The specification says the keyboard may consist of one row of digitals and reeds, or of more than one row. If of one row only—the least complex form—the scale is more than its master, for the scale is not in it. Key characteristics must therefore be cut. This is all I have to say. **George Templeton.**

BEE-KEEPING.

[illegible]—What has become of all our practical bee-masters? Some time ago we had very complete instructions how to make hives and get the bees into them; but none of their signatures have appeared in answer to the query on bee-food. This I much regret, as I think the present is the most suitable time to look up matters which may be of service in the coming spring and summer. I find it rather a ticklish job making "candy." I made some a little while ago, but as it did not seem to be clear of powdered sugar when dry, I added a few drops of vinegar to the next batch. Somehow this will not boil dry and hard, although it is quite clear, and makes excellent butter-scotch, almost as good as the celebrated Doncaster production. But I do not like its appearance, as I am afraid it will become sticky inside the hive. Should anything at all be added to the melted sugar to make it boil clear and hard—if so, what?

Next comes the query, Will bees exist on this or flour cake without some sort of liquid? I find those fed on it often seeking water when they have a chance to get out. I am afraid the present mild weather will eventually be fatal to many stocks, as I find their food consumption is much greater than in severe winters, when they are compelled to keep quiet. A mild winter is often the precursor of a severe frosty spring, and if this happens, very many hives will require feeding to keep them alive.

What is really meant by chilling the brood—that is, what temperature is fatal, and how long must they be exposed to it? Suppose a hive is opened and examined in early spring, if the larva are unsealed, will this exposure be injurious? Also, if they are sealed over, will they hatch out if the combs have been exposed in the air any length of time. These and other kindred matters I hope to see dealt with by some practical bee-keeper, and a few hints on management and preparation for the coming season would be very useful to many.

Orderic Vital.

THE NEW PATENT RULES.

[illegible]—[illegible] say in a recent issue that rule [illegible] will [illegible] draughtsmen. I quite agree with you. I have had over [illegible] years' experience of making drawings of machinery and apparatus of almost every class, and now I must in my old age confess that I am incompetent to comprehend the meaning of the [illegible] rule. If I have a round invention I might be able to compress it within a circle of [illegible] diameter, or a square invention might be shown in a square of [illegible] by [illegible]in., a long invention by a parallelogram of [illegible] by [illegible]in., and a very long narrow invention by a strip [illegible]in. long by [illegible]in. broad. Each of these inventions represents a space of [illegible] square inches, but the question is, would the controller accept any of these inventions as complying with the rule? Neither of the above cases cover more than the prescribed "[illegible] square inches." Again many valuable inventions are comprehended in the mixture of certain substances in definite proportions—what [illegible] drawing will be required for inventions of that class? I am afraid that draughtsmen will not only be [illegible] puzzled" but driven to their wits' end to represent some inventions within a space of "[illegible] square inches." I think it is a very great pity that the Board of Works did not procure the assistance of a [illegible] to advise them [illegible] he would have explained the difference between "[illegible] square inches" and [illegible] square [illegible]

Inventor.

TRICYCLES.

[illegible]—I have read with much interest the letters which have appeared during the last few weeks in your valuable paper upon tricycles, with [illegible]

[illegible] limbs. This hard slogging up hill appears to me to be caused through each treadle in its turn requiring so much pressure putting upon it to force the machine along until the opposite treadle is in a position to receive the strain, and which, in my humble opinion, is nothing short of donkey work.

On the flat ground it is quite different, because the speed one is travelling at (even if it be ever so slow) throws the one crank after the other ready each time it is wanted, except when starting, and then if the crank-shaft and chain-wheel are tight together, and are in direct line with the leg, you must go on "Shanks's pony" a pace or so to put the matter right, or turn the driving-wheel with your hand.

As far as the coil spring goes, I do not see why it should not be of service; but I am inclined to think that if a machine were made so that as the one crank had lost its power—say, by the left foot—the one for the right should be ready to take up the work at once, without having to wait for the driving-wheel to travel over 18in., or 20in. of ground before the work begins. This would bring the machine similar to a locomotive, which can start in any position, the pressure being on round the entire circle traversed by the cranks, and would, in my opinion, assist in hill-climbing better than any other power. As I am not acquainted with many makes of these articles, I should be glad if some of your correspondents could favour me with a sketch of such a machine, if such is in the market at the present time; or the name of it would do, if you allow such remarks to be made. I shall be able to find the maker if the name is given.

Rag.

LIGHT AND HEAT.

([illegible] from p. 411.)

[illegible]—It will be observed that the cause of light vibrations is here attributed to sudden changes in the density of the luminiferous ether. Let these be effected with sufficient velocity, and, considering the infinitely elastic and expansible character of the substance, here is not only a good, but also a sufficient explanation of the luminous vibrations. The greater the velocity of the expansion and contraction of the ether, the greater the brilliancy of the light produced.

There exists an intimate connection between heat and light. Both are forms or modes of motion, and the motion of light is capable of producing the motion of heat and transferring it from one body to another, as, for instance, from the sun to the earth. There is, however, this essential difference between them, that whilst light is the vibrating motion of an imponderable, infinitely elastic substance pervading space, heat is a motion of the ultimate particles of ponderable matter, and is, therefore, unlike light, only conveyed as the motion of heat from one body to another, through the actual contact of material particles existing between the two bodies. The conduction of heat is therefore a transmission of molecular motion from one body to another, and as different bodies possess different powers of transmitting heat, the speed and distance of its propagation vary accordingly.

Heat can be generated in various ways. By mechanical means, as friction, compression, and percussion, by chemical combination and combustion, and by solar radiation, which is the most intense source of all.

The generation of heat by friction, compression, and percussion is a conversion of mechanical energy, and requires for its production, and produces by its disappearance, an amount of force equal to [illegible] foot-pounds for every thermal degree Fahr. As heat and mechanical motion are mutually convertible, no matter the source of heat, this mechanical equivalent of heat obtained by raising a pound of water 1° Fahr. in temperature, is generally adopted in all calculations of heat and work.

Chemical combinations, whether slow or rapid, are usually attended with heat, the same quantity being produced in both cases; although when evolved slowly, as by the oxidation of metals in the air, the heat produced is imperceptible. Combustion is a rapid chemical combination accompanied by the evolution of both light and heat, although the temperature does not depend upon the luminosity, as great heat can be obtained without light, this depending upon whether swift condensation accompanies the combination. In ordinary combustion, such as where the carbon and hydrogen of coal or oil combine with the oxygen of the air to form the products carbonic acid gas and water, and especially when a portion of the carbon condenses at a high temperature into the solid form, light more or less brilliant accompanies the chemical combination, depending upon the velocity of the condensation.

Of all sources of heat, that of the sun is the most intense, although there are no means of estimating it except by the luminosity of the solar surface. This has been calculated to exceed more than [illegible] times the brilliancy of the limelight, the heat of which is estimated at [illegible] C. Of the nature and effects of a solar heat [illegible] times greater than this, [illegible] In this supposi- [illegible] But the speed [illegible] the h.p. [illegible] at 30 miles an [illegible] Then the engine [illegible] as before, although [illegible] In the same order [illegible] be less powerful [illegible] their power as [illegible] steam-engines. It will [illegible] very variable during [illegible] the h.p. is [illegible] be depended [illegible] I shall expose my [illegible] elements of [illegible]

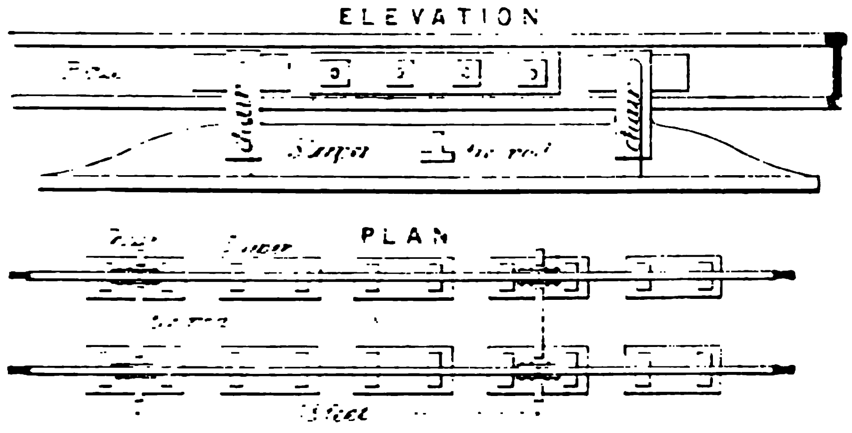
E. Gobert.

[illegible]

CAST-IRON RAILWAY SLEEPERS.

[illegible] "Historian" has [illegible] any part of the [illegible] cast-iron sleepers in [illegible] inquiries [illegible] these sleepers still [illegible] information obtained [illegible] be found upon [illegible] possible that a few may [illegible] siding [illegible]

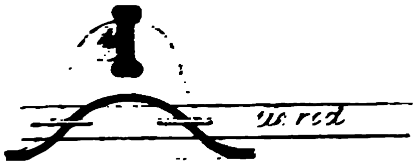
[illegible] permanent way was tried upon [illegible] Midland Railway, and also



[illegible] but for a [illegible] Leicester and [illegible] Midland Railway, [illegible] twenty years, and has [illegible] by the ordinary [illegible]

[illegible] sleepers were [illegible]

[illegible]



[illegible]

[illegible]

times and allow it to fall upon the seat upon which it was intended to rest. Experience quickly proved that a certain amount of elasticity was very necessary, and that perfect rigidity of foundation is most objectionable: stone blocks and cast-iron sleepers have therefore been discarded in favour of the usual wooden cross sleeper.

Clement E. Stretton.

Saxe Coburg-street, Leicester,
Jan. 8th, 1884.

CHEAP LATHES—SLIDE-RESTS.

[22257.]—PERMIT me to thank the gentleman that has supplied the articles on "How to Make a Cheap Lathe." They have been very interesting indeed.

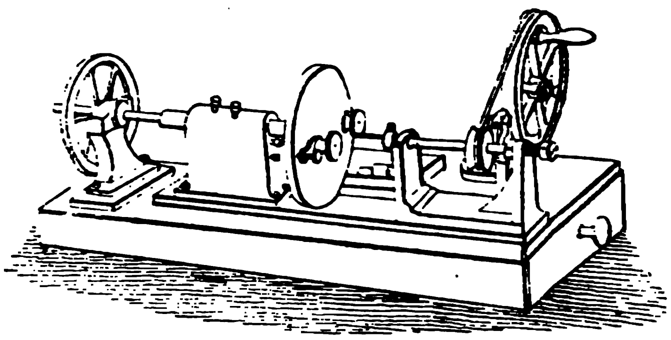
Perhaps our friend would favour us with sketches and necessary information how to make a compound slide-rest for, say, a 4in. or 4½in. screw-cutting lathe. I am sure it would be interesting to many beside myself.

Lill.

HORIZONTAL DRILL.

[22258.]—FOR the benefit of my brother readers, I have sent our Editor a photograph of a small horizontal drilling machine which I designed and constructed myself. It is made for drilling holes from about $\frac{3}{32}$in. down to the smallest size ever required by any amateur. The instrument stands on a piece of maghogany 12in. by 6 by ¾, the height of the centre is 1¾in., and the diameter of the faceplate, to which the work is clamped for drilling, is 3in.

If any amateur wishes to construct one of these instruments for himself, I shall have great pleasure in giving the dimensions through the pages of our



MECHANIC, and will also lend the patterns if so desired, provided postage is paid both ways.

Dundalk. **Thos. J. O'Connor.**

LATHE MATTERS.

[illegible]—THE top bearing slip of the front slide-lathe is, in my opinion, better made of the blunt V form, rather than the common shape for horizontal slides. Of course, the chamfered part may slope towards the bed, instead of away from it as in the diagram. It would then resemble the ordinary V with the sharp edge planed away considerably. Whichever method is used, the V should be cut down so as to get as broad a bearing surface as possible. It is then less liable to get knocked or chipped out of truth, and as a further safeguard against this contingency, the top chamfer seems better on the outer than the inner side of the slip. A semicircular section to this part would seem better suited than any other, as it offers no sharp edges to accidental blows: but I presume it would be far more difficult to fit accurately.

I do not like the plan of canting over the centres, if it can be possibly avoided. Freedom from tremor seems most likely to be attained when the line of fixture passes vertically through the line of centres.

I am very glad Mr. Carre has noticed the plan, and hope it will be taken up by practical machinists. Our pattern-maker has shown how it may be conveniently modelled. The articles by "J. H." are among the most valuable that have ever appeared in this journal. Everything is so clearly planned and dimensioned, that no one can have any difficulty in following the writer's instructions. It is not everyone who knows all about a thing, that can impart his knowledge to others; but fortunately we have in "J. H." one who is both an expert master and an accomplished teacher. In pattern-making there is much that is pleasant and profitable to the amateur who can finish his own. It is a matter requiring neatness and accuracy in workmanship, and needs a steady hand and a careful eye. With such instructions as those given by "J. H." no one can be puzzled to know how a thing is made; but the measurements are equally as important as the sketches, for there is a certain proportion of parts which gives a thing neatness and stability. The desideratum is to give just so much metal as is needed, and no more: any needless strength must be an incumbrance. This is just the point where the experienced eye can render useful services: hence, I regard the papers and diagrams on lathe construction as far superior to many previous ones of a somewhat similar character, and I trust your obliging contributor will in future papers enter upon more complex lathes and machine tools, not forgetting also the steam-engine.

Orderic Vital.

LEGAL REPLIES.

[22260.]—BILL ON DEMAND (52583).—This query has been fully answered by "C.," but answered according to the special rules of the Scotch law, which may mislead other readers. In England a bill drawn payable "on demand," &c., "bearing interest," would carry interest at the rate of 5 per cent. per annum, in the absence of any other agreed rate, from the date of the bill itself. The Statute of Limitation begins to run from the date of a bill made payable "on demand," and therefore no action could be supported upon the bill more than six years after this date. But if interest were paid upon the bill, this would keep the right of action alive, and an action could be brought for the whole sum due within six years from the last payment of such interest.

PROVING A WILL (52600).—This, too, has been answered; but I think it is only fair that a few words of warning, and to prevent disappointment, should be added to "Collector's" very *rosy* view of the easy way in which a will *is proved*, and which, indeed, is only true when the will is in every respect formally complete. If the attestation clause is quite accurate, and there is no flaw in the executor's oath, the business is simple enough. But it frequently happens that the will requiring proof is very informal indeed, and then, however polite the Inland Revenue authorities may be, they cannot show an executor how to get through the business. A lawyer must be consulted to say if the will is worth anything at all, and to draw the necessary affidavits for the attesting witnesses to prove signature and attestation.

DETAINING LUGGAGE, &C. (52724).—I never heard of the presumed right of a tradesman to stop a customer's trunk for an unpaid account for grocery goods sold. The idea is simply preposterous, and can only have arisen owing to the great confusion that exists in many people's minds as to the legal right of lien. A vendor can retain the goods he sells until the price is paid, if he chooses, but this is the full extent of his lien: and neither he nor anyone else can seize them afterwards without a lawful process of execution or distress. Workmen and the like have a right of lien upon articles they repair until paid: but they cannot retake them if once credit be given. The claim mentioned by the querist is quite unfounded.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall, E.C.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested [illegible] the number and the title of the query asked.

[illegible] —**Learning the Zither.**—This instrument is [illegible] difficult to learn; but may be [illegible] much difficulty by taking a few [illegible] master. Don't trouble yourself [illegible] books, they are more trouble than [illegible] I made great progress in two [illegible] but six lessons, and now can play [illegible]—M[illegible].

[illegible] —**Brush Dynamo.**—As I expected, [illegible] and commutator are entirely wrong. If you will carefully consider the action of the [illegible], you will observe that each coil is short-circuited for about five-sixths of a revolution, so that you are not getting one quarter of the real power of your machine. If you want to use your present commutator, you must connect your machine up as a [illegible], as I explained at first, and I have no doubt you will get much better results. A proper Brush commutator for your machine would consist of three brass rings, each cut into two halves and insulated from each other, and the two ends of opposite coils joined, and their beginnings connected one to each half of a ring.—W. H. E., Coventry.

[illegible] —**The Cheapest Food.**—May I call Mr M[illegible]'s attention to the fact that his reply on p. 411 is no answer to my question as to what is the composition of the foods he has now twice advertised gratuitously? No one disputes, so far as I know, that they are wholesome or delicious; but they are not cheap, for Scotch oatmeal and crushed wheat, while quite as delicious, are very much less in price. It would, I think, be absurd if any one asked for the cheapest drink, to suggest Bass's bitter, which might fairly be described as wholesome and delicious, but scarcely cheap to the man who wants at least half a gallon during the day. As I have [illegible] to the drink, can any one suggest anything better than the infusion of oatmeal, treacle beer, or [illegible] beer for those who literally earn their living by the sweat of their brows and require large quantities of drink in the course of a hard day's work?—S. R.

[illegible] **Watch Jobbing.**—English turns can be bought, large size 8s. 6d., 9s. 6d., and 10s. 6d. each, small pivot turns with steel rest and two centres, 4s. 6d. for watch work only. Swiss can be bought with eight centres, six fitted ready for use, and steel rest [illegible]. I think the Swiss most useful for clock and watch work combined. Respecting the spring hook, first see that your spring is the proper length required for the barrel, make a small hole a little from the end, a round hole preferable, chamfer the inner side to receive the burr caused in riveting. [illegible] your steel, square or round, and fit to the eye of your barrel easily, then file the seat for spring as shown in Fig. 1. Be careful to make a

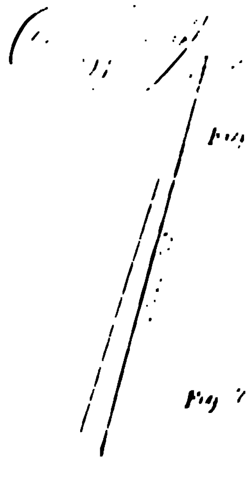


Fig 1

Fig 2

[illegible] then tap the [illegible] a notch with a screwhead file near the point, file the sides a little with that file, so that a small eye may take hold which should be very near the end in this case, and filed thin. Screw in your hook (be sure it stands right way for the spring) until the hook is visible inside, cut it off and file up, polish, &c. A bow screw will sometimes answer the purpose, as in Fig. 2.—MODEL.

[52338.]—**Holtz Machine.**—I am glad to see in Mr. Holmes's answer that the discrepancies of "Another S." have been pointed out independently of myself. I quite endorse his opinions. I am afraid "Another S." is quick at jumping at conclusions. The plates I mentioned in Mr. Spottiswoode's great machine, weighed about ¾lb. at the utmost, and cost 4s. 6d. per lb., so I don't quite see how they would mount up to £2 10s. each. Again, "Another S." is rather caustic with me for mentioning that "although I went a walk in the country after working in the same room in which the machine was running, my clothes still retained a powerful smell of ozone." I merely mentioned this to give an idea of the vast quantity generated. He must also have a comparatively small experience with ozone, as any physiologist or physicist will tell him that ¼ a per cent. of it in air will be sufficient to make the eyes smart and the lungs to be seriously affected for some hours after inhalation for an hour, or even less.—P. WARD.

[52354.]—**Gelatine Transparencies (U.Q.)**—If "Glatton" has met with any special difficulty, and will say what it is, I shall be happy to try and help him.—W. ROBINSON, JUN.

[52362.]—**Engineering (U.Q.)**—Since the diameter of the screw = 2·756in., the circumference of it will be 2·756 × 3·1416 = 8·6582in. nearly, and the pitch of the screw = 5in. The above dimensions will be the base and perpendicular of a right-angled triangle, and the hypotenuse will be the thread of the screw. The angle between the base and the thread can be readily found with a protractor; or by logarithms we have—

$$\begin{aligned} \text{Log. } 2{\cdot}756 &= 0{\cdot}4402792 \\ 3{\cdot}1416 &= 0{\cdot}4971509 \\ \text{Log. } 0{\cdot}9374301 &= 8{\cdot}6582 \text{ nearly.} \end{aligned}$$

And if A be the angle between the thread and the base, we have—

$$\text{Tan A} = \frac{5}{8{\cdot}6582}$$

$$\begin{aligned} \text{Log. } 5 &= 0{\cdot}6989700 \\ \text{Log. } 8{\cdot}6582 &= 0{\cdot}9374301 \\ \text{Log. tan. A} &= \bar{1}{\cdot}76[illegible] = 29°\ 42'\ 21''. \end{aligned}$$

Since 1 horse-power = 33,000 units of work done in 1 minute, and the work done in 1 hour by the burning of 2lb. of coal = 33,000 × 60 units. But 1lb. of coal contains 12,000 units of heat; and the mechanical equivalent of 1 unit of heat = 772 units of work. Then the work done: the theoretical work : : 33,000 × 60 : 12,000 × 772 × 2: or—

$$\frac{\text{Actual work}}{\text{Theoretical work}} = \frac{33{,}000 \times 60}{12{,}000 \times 772 \times 2} = \frac{1}{9{\cdot}357}$$

or less than 1/9th of the heat contained in the coal is utilised. See Godwin's "Elements of Mechanics."—A. GRAY.

[52[illegible].]—**Photographs (U.Q.)**—First size with gelatine (about 20gr. to 1oz. water), then coat with [illegible] varnish.—W. ROBINSON, JUN.

[52[illegible].]—**Gem Lenses (U.Q.)**—1. It is usual to [illegible] screen with partitions in front of the sensitive plate, to prevent the images over-lapping: but, [illegible] deal depends upon what distances apart the lenses are placed. 2. Yes, just the thing if the lenses are good.—W. ROBINSON, JUN.

[52[illegible].]—**Chemical Problem (U.Q.)**—Will [illegible] state where he found this question?—[illegible], Elswick Science School.

[52[illegible].]—**Chemical Problem (U.Q.)**—The heat of combustion of methane is 213,530 units; [illegible] the elements constituting the gas were burnt [illegible] the total heat evolved would be [illegible] [illegible] units, and the difference between this and the amount actually yielded is obviously the amount absorbed in decomposing the gas [illegible] heat of formation of methane = [illegible] units.—WM. JOHN GREY.

[52[illegible].]—**Dynamo.**—This query can be answered by telling "W. W. W." that it depends on how he makes his dynamo. Most bearings can be felt with the hand; but if he is the least afraid he can use a paraffin candle to test the temperature of the metal. Most likely it will spoil the other lamp unless you shunt the current off or introduce a resistance equivalent to that of the lamps put out. [illegible] take all the work of a machine and [illegible] end in the destruction of its insulation and finally the melting of the copper.—S. P. T.

[52[illegible].]—**Legal.**—The coal goes with the land unless specially devised.—LIMB O' TH' LAW.

[52397.]—**Raising Water.**—This query is too indefinite. What is it the querist wants to know?—ESSAR.

[52405.]—**French Polishing.**—I suppose if Mr. Watkinson rubs his black paint or varnish down until he gets a smooth finish, and then French polishes, he will obtain what he desires. Surely he does not imagine that a carriage is covered with one coat of black paint and then varnished.—NUN. DOR.

[52408.]—**Skin Disease.**—A more simple (I do not presume to say a better) remedy for ringworm than that proposed by "Etheropathy," and one at hand in every mechanic's house, is thinly-made mustard. With the tip of a finger rub this semi-liquid, first outside the sore, then over it, always rubbing in a circle, and gently, and for a few seconds only. Repeat twice a day whilst necessary. For a child, it is a painful cure; but a grown-up person will not mind a few hours' smarting, and will find the cure rapid and effectual. Some people use ink in the same way.—H. O'B.

[52415.]—**Rushton's Self-acting Fountain.**—The description or the illustration is wrong. Try the arrangement on p. 260, or look in Nos. 45[illegible], 58[illegible], 801.—SENEX.

[52420.]—**White Fillings for the Teeth.**—The recipe must, I think, be correct, as I saw the same in the *Lancet*; but here is a good filling: Anhydrous phosphoric acid 12gr., pure caustic lime 13gr. Powder very fine. Mix and apply quickly, smoothing with a wetted finger.—NUN. DOR.

[52421.]—**Partnership.**—This querist should, it seems to me, consult a solicitor directly, and pay the usual fees.—LIMB O' TH' LAW.

[52423.]—**Paint for Machine Tools.**—Have your colours thoroughly well ground in turpentine, and then mix with oak or copal varnish.—E. C.

[52424.]—**Red Casting Wax.**—Add a little vermilion to ordinary wax, if that is what you mean.—E. C.

[52427.]—**Adhesive and Waterproof Paste.**—The German recipe is no doubt the cement made of casein; but it is doubtful whether the querist will find such a paste as he seems to want. Still, he ought, by looking up back volumes, to get an idea or two.—NUN. DOR.

[52428.]—**Battery.**—There is nothing so convenient of a small size as the chloride of silver cell; but Trouvé makes up small bichromates for use with his illuminated "doublets" or real rubies, &c., and also for the "animated" scarf pins and brooches. The chloride of silver cell is about the best you can have for a pocket medical coil.—NUN. DOR.

[52437.]—**Paper Ornaments and Toys.**—These are made of the pulp, I believe, and dried while in the moulds.—S. T.

[5244[illegible].]—**Paper Bricks.**—How would papier-maché do?—S. T.

[5245[illegible].]—**Belt Working off Pulley.**—I am sorry to inform W. Hoskens that I cannot explain to him how it is contrary to mechanical law that the belt works off the pulley at the sides which are nearest together. But the proof of the pudding is in the eating thereof. I would advise him to try it for himself, and I think he will see for himself that what I stated is correct. In fact, I have tried it many times, both on horizontal, diagonal, and vertical shafts, and invariably I have found what I stated to be correct.—FIRER, Dewsbury.

[524[illegible].]—**Belt working off Pulley.**—The blunder which is apparent in Mr. Hosken's reply is a very common one among people who reason that because a belt runs towards the highest point (viz., the centre) of an ordinary pulley with a convex rim whose shafts are parallel, it would do the same thing by running "up hill" when the shafts are not parallel. This is just where the "laff" comes in, though, friend Hosken, and is not "contrary to mechanical rule." Indeed, the only mechanical rule which has anything to do with belts running on pulleys unguided is the one quoted by me on pp. [illegible]. If you wish to "practice" yourself and "draw your own conclusions," you may do so by adopting the method recommended by "W. W.," pp. 550. Having made the string or straight edge correspond with two edges of one pulley, and one edge of the other, the shafts not being parallel, it will be observed that there is a space between the string and the remaining edge of pulley. This space represents the pitch of a screw-thread, and the belt will screw itself off, "down hill," at a rate equal to this pitch.—W. J.

[52[illegible].]—**Pianoforte Action.**—I should be very glad to help "G. B.", but I cannot quite understand what he means by "a hammer-rail action for a cottage piano with damper action combined." If by this he means an ordinary cottage action—which certainly would include a hammer-rail and damper action—he will find illustrated directions on page [illegible], Vol. XXVII. But, should he wish for an action with the dampers attached to the hammer-rail, such as are generally known as "under dampers," I will do my best to illustrate and describe for him a simple action of the kind.—W. H. Davies.

[52520.]—**American Organ, 16ft. Stop.**—Thanks to Mr. Fryer and "Organon" for opinion and advice on above. Mr. Fryer's specification entirely accords with my own idea, formed since the instrument in question was made. Would it not be better, however, to have both the 8ft. stops to run throughout? The organ my friend is making is for use in a chapel; therefore, the object is to obtain the maximum of power at the minimum of expense. The instrument I have made is also used in a large schoolroom; and were it not for the fact that the parties most concerned seem quite satisfied with it, I should be inclined to reconstruct it in F scale, with two sets of 8ft., one of 4ft.; solo set of 16ft.; sub-bass and super-octave coupler. I must protest against the instrument as it stands being dubbed a failure, as "Organon" sees fit to do. If it is a failure, then Mason and Hamlin's "Queen's Model" is a failure; for if the pitches marked on the stop knobs go for anything, it is identical for all practical purposes. Also in two-row harmoniums the second row is usually of 16ft. pitch. As regards the voicing, I did that myself, as I find I can produce as good a tone as any I have bought ready voiced, including some Munro reeds stated to be voiced in the company's factory. I find, however, a difference in the boards. A 1½ row I have just been voicing gave a good tone easily; whilst another I voiced some time ago could not be made to do so, although voiced in the same manner. I rather think the best makers throw aside these inferior boards, and only use those which, on trial, give good results. Why should not the tone of an American organ depend as much upon the quality of its soundboard as that of a fiddle does upon the quality and proportion of its various parts? Thanks to "Organon" for his idea of a two-manual; but if I made a two-manual, I should be inclined to have rather more than four rows.—J. E. Floyd.

[52543.]—**Pivot.**—It is evident from the query put by "B. W." that he is not a practical watchmaker, and as the repair he wishes information on is one requiring dexterity, he would do well to put the job into some one's hand who is experienced. The old balance must be removed by using suitable punches, to be obtained at any tool-house. The new balance riveted on by another kind of punch, after placing the banking-pin in front of the cylinder opening. With regard to the 'scape-wheel, the arms must be bent by gently tapping on a hollow stake: or perhaps the cylinder is too low.—W. H. Huddy.

[52548.]—**Wharf Crane.**—I am much obliged to Mr. W. Hosken for replying to my query on p. 393, but I fear my question was misunderstood. I do not want a crane, but wish to know how to calculate the weight a crane I have should lift with safety. It is a wharf crane of the simplest construction, worked by hand. I want to know what dimensions I saould take of this or any other crane to calculate its lifting capacity.—Vaga.

[52553.]—**Photographic.**—1. Although I hardly think the difference would be so great as stated, it must be borne in mind that, all things being equal, a single lens will work quicker than a doublet. 2. Yes. 3. Yes. 6in. focus I should consider best for general purposes.—W. Robinson, Jun.

[52558.]—**Food for Bees.**—It is kind of Mr. H. Wilson to try and supply "O." with what he requires, but not so to characterise his informant *re* "lemon-juice," as an "old woman," and the information "bosh," because it does not suit his views. I think most modern bee-keepers, and all modern bee-masters, will think the information that bees are partial to the flavour of "lemon, oil of mint, or butter," quite as open to H. Wilson's term "bosh"; for how are we to ascertain that they have any particular liking for any of these three flavours? Vinegar, or some kind of acid, is used in making syrup for bees, to prevent the sugar recrystallising. Oil of mint is used for scenting syrup when uniting bees, and butter is used for greasing tins or moulds, to pour candy in, so that it will easily leave the moulds when it is set. I fail to see why the fact of H. Wilson's boiling "1½ ton of sugar into various kinds of candy per month" can render his recipe any more genuine or difficult to beat. If he had boiled it all for bee candy, we should have thought him more of an authority. Is he a bee-keeper, I wonder?—J. I. S.

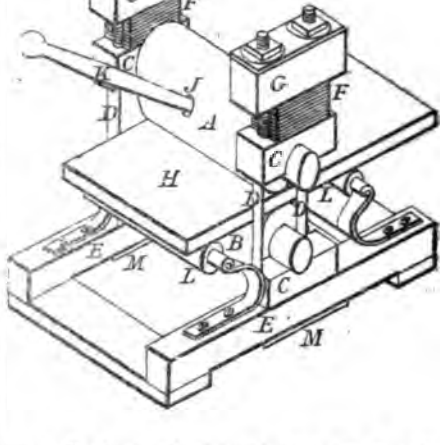
[52563.]—**Harmonium.**—"Fliegen" (p. 413) seems to misunderstand why I did not answer the previous questions put forth by him in a recent number of the "E. M." I do not imagine now a days that there are any very great trade secrets of any great value with regard to the construction of the harmonium, although great improvements have been made in harmoniums of late years, but the size for the holes at the top of the wind trunks is, certainly, no trade secret, as the querist imagines (p. 413), although it is of some little importance. The reason that I did not answer the questions put forth in the queries, was simply because I thought they were asked out of idle curiosity, and I must apologise to the querist if my presentiments are wrong. "Fliegen" will find that five holes of 1½in. diameter over each trunk will be a sufficient number, and with regard to the fixing of the escapements, if he can get a sight of the interior of a 2½ row harmonium, he will learn more than any number of words can teach him. There is more than one method employed in the fixing of the escapements, valves, &c., and any well-meant query from "Fliegen," or any other reader will, undoubtedly, receive my strict attention.—G. Fryer.

[52577.]—**Organette.**—I will write out the promised instructions on the making of an organette in a week or two; and as "T. J. P." (p. 413) has stated that the music which is sold is not the sort of music he wants, I shall be glad to know from him what kind of music he really does require, as both sacred and secular can be readily obtained from almost every respectable music shop at a very reasonable cost. If he will advertise his address, I will forward to him a list of tunes procurable for the organette, which comprises dance music, operatic music, sacred music, and overtures.—G. Fryer.

[52577.]—**Organette.**—As the original inventor, and first constructor of reed instruments automatically played by means of perforated strips of paper, or other material, I may be able to help your querist "T. J. P.," who inquires about the best scale to use. I may perhaps begin by explaining that there are two distinct ways in which the perforated strips are used: in one it acts directly as a valve to close and open the air passages, while in the other it acts as a "stencil" to a set of levers which open and close valves that cover the air-holes. To the former class belong the "Orguinette," the "Auriphone," the "Harmonette," &c.: to the latter belong the "Organette," the "Organina," and I think the "Orchestrionette." There are advantages and disadvantages in both classes, which I need not now go into, except to point out that, speaking generally, the openings (and consequently the strips) require to be much longer in the instruments where the paper acts directly as a valve than where it serves as a stencil. At first sight it would seem that by making a short perforation travel slowly over the air passage it would serve as well as a longer one; but I have found that this is apt to cause a droning, sluggish effect if carried out too far, and I think for promptness of speech in the reeds the "stencil" arrangement is the best. I also consider the mechanism of the "Organina" preferable to that of the "Organette," but this is merely my own opinion, and must go for what it is worth. Now for "scales." When I first commenced my experiments (nearly 25 years ago) I used a chromatic scale of 18 notes, but I afterwards found that it was better to have an imperfect scale extending over a greater compass. The scale of the "Organina" is the following:—B flat, C, D, E flat, E, F, F sharp, G, A flat, A, B flat, C, D, E flat, F, G, in which the B naturals, the C sharps, and the upper F sharp are omitted. This scale would, I think, be improved by the insertion of the B naturals, and the omission of the A flat, as though the F sharp provides for the key of G major, the B natural is much needed in this key, and the want of it, especially in chords, is decidedly felt. If "T. J. P." buys his music strips he must, of course, arrange his reeds to suit, but if he makes an instrument, and cuts out his strips for himself he can select what scale he pleases, and in that case the diatonic with the insertion of C sharp, F sharp, B flat and E flat, with (if he wants to omit any notes) the F naturals left out, will give a good variety of keys—viz., C, G, D, F and E flat—all major, with (to a certain extent) their relative minors—A. S. L.

[52580.]—**L. B. and S. C. Engines.**—Outside cylinders were never used on this line.—Machina.

[52582.]—**Copperplate Printing.**—The accompanying isometrical sketch will give "Copper" an idea of the press he wants, and is quite within the constructive powers of an ordinary amateur mechanic. The two rollers A and B are 9in. long and about 4½in. in diameter; the journals project 1¼in., and are fully 2in. in diameter. The upper roller must be of lignum vitæ, as the surface of any softer wood gets dented by the edges and corners of the copper plates passed through the press. The lower roller may be of any hard wood—beech, hornbeam, oak. The rollers revolve in bearings C C C C (one not seen in sketch), of beech or hornbeam. These bearings are made by boring a hole 2in. in diameter in two little blocks 4in. square and 1½in. thick, and then cutting them in halves, with the grain. The bearings are supported by four stout 16in. bolts D D D D, which pass through holes in their ends, and also through the bottom frame of the press E E. Upon the top of the upper bearing about fifty thicknesses of cardboard (old playing cards do very well) F F, to give some elasticity to the pressure. Above the cards come the caps G G, strengthened by iron plates ½in. thick on the upper side, and held down by square nuts and washers; between the rollers the plank H, of lignum vitæ, 9in. wide, 18in. or 20in. long, and 1in. thick is fitted. The



upper roller has a hole, J, bored, 3in. deep, in which a stout round iron lever K (the best end of a burnt-out kitchen poker will serve), by which the upper roller can be rotated, as a ship's windlass is by a handspike, through three-fourths of its circumference—say, 12in., giving the same travel to the plank H. Plates of iron M M, having square holes to take the square part of the bolts, D D, and, to prevent them being drawn into the wood, must be fitted under the pieces E E. All the holes for the bolts D D D D must be carefully bored the same distance apart, and close fits. The small rollers L L are to keep the plank H in a horizontal position. A better form of press would have a square iron axle to the upper roller A, but adds very much to the difficulty of construction. The inked plate is laid upon the plank H, with paper and two or three thicknesses of printer's blanket upon it, and by hauling on the lever K the plank, plate, paper, and blankets are drawn between the rollers and may be taken out on the other side, the next impression being taken the reverse way, or the roller may be returned so that the plate gets two squeezes. The rollers must be truly cylindrical, the faces of the plank truly parallel, and the pressure on each journal equal. I suppose "Copper" knows all the little dodges of inking and wiping, and cleaning the plate, as upon these depend, in a great measure, the value of the results.—Robinson Crusoe.

[52584.]—**Magic-Lantern Lamps.**—Your burner must be dirty. Take top off and thoroughly clean perforated work out, either by brushing with stiff brush or well washing in soda-water (do not boil it, as it turns it black), put together again and put into oven to dry. Use crystal oil or kerosene.—W. Jones, Viaduct-street, E.

[52585.]—**L. and S. W. R. Engines.**—The numbers of the 46 class on this line are: 46, 123, 130, 132, 133, 374, 375, 376, 378, and 379; 124 was originally one of this class, but has lately been rebuilt and furnished with an extra pair of wheels behind, and the vacuum brake apparatus. There are twelve of the 380 class; they are Nos. 380 to 391 inclusive. The numbers of the new bogie tank passenger engines with ten wheels are, I believe 416 to 427 inclusive.—Machina.

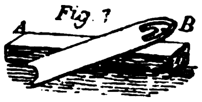
[52586.]—**L. and N. W. R. Engines.**—I am obliged to "H. N." for his reply, but it contains several errors. "L. and N. W. R. Engines" should be "L. B. and S. C. Engines"; whilst inside cylinders is evidently a mistake for outside. Again, there could have been double bearings to the driving-wheels only. The present 172 (Chichester) is not a coupled engine, but a 6ft. single (Craven) of the 194-200 class.—W. B. P.

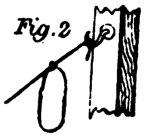
[52589.]—**Battery.**—You would want about 200 of the kind you mention: they are useless. The best kind can be made thus:—Outer cell, a rod of carbon; porous cell, zinc (amalgamated). Pack the outer cell with pieces of broken carbon, *not* dust, and fill up with a solution of—outer cell: bichrom. potassium, saturated solution, 1 part; sulphuric or muriatic acid, 2 parts. Inner cell—saturated solution of common salt. With 4 or 5 of these cells and a low-resistance incandescent lamp, you may obtain a light of about 4 or 5 candles. The duration would be about 5 or 6 hours continuously. The cells should be at least about 6in. high.—Cosmos.

[52593.]—**Clayey Soil.**—Your soil will be v suitable for potatoes, especially the kidney va ties, among them such well-known sorts as Y tain it will work properly, is not to be obtained any day in the week, and he is certainly possessed of an amount of common sense and judgment which he will have the common sense and judgment to expend on his own advancement in more profitable work. A man who buys a gas stove or gas fire without understanding the conditions under which it is to be used, is as likely to be suited as a man who buys a cart-horse for hunting purposes, and cannot understand the possibility of the cart-horse being a good one, if he cannot use it as a hunter.—THOS. FLETCHER.

[52633.]—**Gas Flames.**—The increase in light-giving power when two flames are caused to play on each other, is real; but the thing is nevertheless a "catch," as a single good burner, burning the same quantity of gas in one flame, will give quite as much light; in fact, under practical conditions, the single burner is much the best, as the compound burner, if turned low, is extremely liable to smoke. The larger the quantity of gas which can be burnt in a single good flame, the higher the proportionate light obtained, and it is therefore much more economical to light any given room with one large burner than with two or three smaller ones. The light of any burner can be increased by turning the jet until it slopes slightly downwards instead of upright, making a horizontal saucer-shaped flame; but this also has the practical objection that if turned low it is very liable to smoke.—THOS. FLETCHER.

[52639.]—**Netting.**—The instruments for netting consist of a needle (B) and a mesh, A, see Fig. 1. From 8in. to 10in. is a good length for the needle, while the mesh stick must vary according to size of net. A mesh stick will make a mesh twice its own size. Thus, a stick ½in. square will make a 1in. mesh. To fill the needle, pass the string round the tine, or inside point, round the heel of the needle, then up round the tine again, until the needle is full. Now fasten the end of the string to a hook and tie a loop in it, Fig. 2. Then lay the mesh stick underneath the string, and pass the needle up through the loop, Fig. 3. Then pull it tight, so that the end of the loop rests against the mesh stick, Fig. 4. Now comes the important part—the formation of the knot. Hold the mesh stick in your left hand with the thumb on the string, and with the needle in the right hand; now with a quick jerk throw the bight or loop of the string over the stick and left wrist, as shown in Fig. 5.





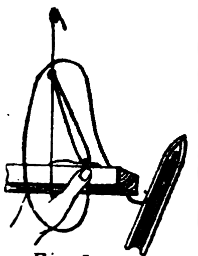
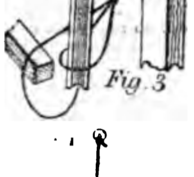


Fig. 5



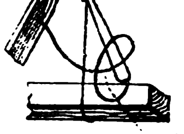
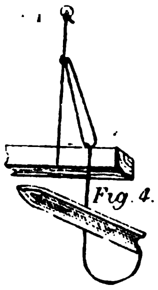


Fig. 6.



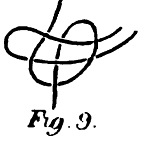


Fig. 9.

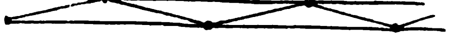
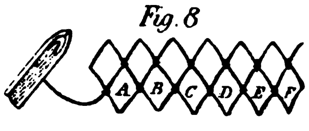
Fig. 7.


Fig. 8


Then push the point of the needle up between the first loop made and the string to the left of it, pull the needle through, and bring the knot into shape (Fig. 6), then tighten by pulling the needle in the direction of the dotted lines, and the knot is tied. This simple knot is the foundation of all net-making, and once succeed in that and you will very soon be able to manufacture almost anything. Now slip out the mesh stick and take the same stick through the loop you have just made, and so continue on, passing the needle every time through the last loop made, until you have made enough. By the time you have made as many as you think requisite, your work ought to look something like Fig. 7. Now unfasten the end from the nail and untie the first loop made. Now pass a piece of cord through the upper row of meshes, tie the ends of the cord together, and hang it over the hook. Now go on with the work as before, only do not slip the loop off the stick as at first. Knot through F (Fig. 8), then through D, then C, and so on, until you have travelled along the whole width. Then turn the work over and travel back again in the same manner. Presuming the string breaks, or you wish to join another ball, the way to do it is with a "becket-hitch," commonly called a "wêaver's knot." Form a bight, pass one part up through it, then over, under and back through its own loop, Fig. 9.—CHEMICUS.

[52643.]—**Silber Lamp.**—Defect is in the reservoir. Take burner out and empty all oil out and rinse with clean oil; replace old cotton with new, then light up.—W. JONES, Viaduct-street, E.

[52643.]—**Silber Lamp.**—What F. Search complains of is the great fault of the Silber lamp. The wick not forming a complete circle, the two edges of it tend to separate as it is wound up. When the separation exceeds ⅛in. or more, gas forms in the open space, and it is the explosions of this which put out the light. To cure it, see that the edges of the wick are in contact before lighting.—M. D.

[52649.]—**Varicose Veins.**—"Poor Sufferer" should get an elastic stocking, to be worn when out of bed; or, if he wishes, he can have it radically cured by a surgeon with but little pain or risk. The stocking is only palliative; the operation is curative.—M. D.

[52649.]—**Varicose Veins.**—My experience, which is for more than a quarter of century, is that a flannel bandage is far better than any other. I adopted it by the advice of an eminent surgeon (the late Dr. Cusack, of Dublin). Fine flannel torn the lengthway, 3in. wide, to allow for washing—mine are eight yards long, as I have to wear from toes to over the knee. I buy from three to five yards of flannel, tear it in strips, and put them together with a flat seam. In putting it on the edges should be well overlapped, and where a crease occurs from the varying shape of the leg, fold over the bandage so as to have it perfectly smooth.—M. B.

[52649.]—**Varicose Vein.**—Much more effectual than ordinary surgical bandage, and much cheaper than an elastic stocking, is Esmarch's bandage—a surgical elastic bandage. With this my one leg, in which there had been obstruction, has been reduced an inch and half in circumference, in three months, even when measured after the day's walking. "Poor Sufferer" should learn to put it on in a figure of eight, and will find it the greatest comfort and support. On no account fasten it with tape—the reason why not is obvious. Use a safety pin. Some doctors recommend Miller's (I think) bandage as a certain cure for varicose veins. It is a strong bandage of uncovered indiarubber; the cost is, I believe, a guinea. Esmarch's bandage, which is cheap, has been more benefit to me than the best elastic stockings that I have been able to get costing 30s., and worn out in a few months.—H.

[52653.]—**Electrical Currents.**—The matter can be best explained by attention to the following simile, which appeared some time since in a popular magazine, "Let the resistance be represented by a ditch, which varies in width at various points of its course. Now, you have a plank 10ft. long and 1ft. broad, and you take it to where the ditch is 10ft. wide. It is clear that at this spot the plank will just stretch across. Now go to a spot 20ft. wide, and saw down the centre of the board, so as to cut into two boards of ½ft. width. By joining the ends we get a plank 20ft. long and ½ft. wide. Now take your plank to a place where the ditch is 5ft. wide, then you will have to saw your board across and join sideways, obtaining a plank 5ft. long and 2ft. wide. Thus the broader the ditch, the narrower and longer the plank; and the narrower the ditch the wider and shorter the plank—the quantity of wood always being the same." The ditch is ohms and the plank watts; the length volts, and breadth of plank, ampères. Does not "Antares" see that it is not the current that is spoken of, but the energy? Cannot a current carrying 4 watts of energy be represented as 4 volts and 1 amp., or 8 volts and ½ amp., or again, 2 volts and 2 amp.? And with a fixed E.M.F. the current may vary in ampères (as in the case of adding cells in multiple arc). With respect to "Antares's" last two queries, I presume he refers to the pressure of the "magnitudes" at the same time. This can only mean W = E C, where W = energy in watts, E = potential in volts, and C = current in ampéres. The amount of energy cannot be measured directly on the galvanometer, but it can be on a watt meter. If the querist wishes to have a thorough comprehension of the subject, together with explanation of the chief instruments employed, he cannot do better than obtain Mr. Shoolbred's lecture on measurement of electricity in the *Society of Arts Journal* for April 6th, 1883, or in the *Electrical Review* for April 14th and 21st—preferably in the former, as they are illustrated therein.—COSMOS.

[52653.]—**Electrical Currents.**—My inquiry, 52653, has elicited three such important replies, that perhaps you will allow me to supplement it by the following extracts from the Parliamentary Report on the Electric Lighting Bill Committee of 1882, proving that, by the distinguished witnesses named, current is regarded as possessing two qualifications:—"2197. Mr. Spottiswoode: Currents having sufficient strength or quantity, and sufficient E.M.F. or tension. These quantities are perfectly measurable, and suffice to define the current or supply." "2475. Dr. Siemens: With a potential of 150 volts no danger would arise in the case of a man standing near a naked conductor." "2565. Dr. Hopkinson: Electric energy can be distributed, being taken in the form of great pressure and little quantity, or a little pressure and great quantity—just as water can." "2841. Electricity can be defined to the consumer as gas of so many ampères and so many volts." There are others to the same effect; and it would seem that the volt, or E.M.F., is no longer to be confined to the battery or dynamo as a measure of the generating force; but is to be considered as also belonging to the current which is produced. The passage in Mr. Sprague's book is that on page 205, which "Sigma" mentions. I am delighted to hear that a new edition of this work is so nearly ready; for the work as it stands has often cleared up for me difficulties raised by reading other textbooks. And as currents are now admitted to vary in "density," of which the galvanometer takes no cognisance, it is to be hoped some other instrument may be described *which will*. The water analogies which "Electricus" says are "quite wrong" were quoted from memory; but I think the illustration was, that just as a wide and voluminous mass of water with a fall of, say, 3ft., may yield the same horse-power as a far less quantity of water falling from 30ft., so two electrical currents possessing different qualities of "tension" may have the same effective power in producing light or motion. I do not understand this, I confess, especially as it is stated that one of these two currents (having "high tension" may kill a man who places himself in the circuit; whereas the other (having "low tension") may be handled with impunity. As to measurement, the following from the same Blue Book is interesting: but the apparatus measures "electricity" in the lump, without distinguishing between the component parts of the current:—"3102. Mr. Johnson (Edison's agent) describes a meter as measuring accurately the $\frac{1}{80}$th part of the current which the consumer uses. This is done by electric deposit, two metal plates in a solution being weighed at intervals, and the mean of the loss of one and the gain of the other is known to represent the $\frac{1}{80}$th of the total electricity that has passed into the house." Perhaps it may be taken that the terminology of the science is not quite settled yet; and as the volt has been found susceptible of two applications, it may be hoped that a similar economy can be practised with other units also, and that the philosophers will not insist in requiring the whole array of volt, ohm, ampère, coulomb, and farad, besides erg, dyne, watt, and joule, to express the practical phenomena of electricity.—ANTARES.

[52656.]—**Electric Communication.**—I should recommend Mr. Brown to use No. 22 or 24 cotton-covered copper wire for connections if indoors, and tape-covered wire tarred for outside work.—JOHN HALE, Univ. Coll., London.

[52658.]—**Expansion Valve.**—The very name of the valve points out the advantages—viz., the expansion of steam; consequently, the saving of steam. You give no particulars whatever by which you can receive a reliable answer. But if your valves are worked by eccentric, place the expansion eccentric with its full throw opposite the crank; now move the piston forwards, the distance you wish it to have travelled when steam is shut off. See if the expansion valve is closed; if not, close it by the division-thread, and your valves are set.—ENGINEER, Dewsbury.

[52659.]—**Soft Spelter.**—For iron, equal weights of copper and zinc; for silver, melt two parts of silver, then add one part of clean brass wire. If required harder, add more silver; if softer, $\frac{1}{30}$th part arsenic.—P. WARD.

[52659.]—**Soft Spelter.**—A good way of brazing light ironwork without heat at all is to take 2oz. of brass filings and 1oz. of steel filings, and put them into ¼oz. of fluoric acid in an earthenware jar.

[illegible] the work with them and press [illegible] can make a white solder for [illegible] silver with [illegible] of tin.—JOHN HALE, [illegible]

[illegible] — **Electric Gas Lighter.**—The proper [illegible] for charging this battery are: Sal-[illegible] grammes, water 1 pint. I presume [illegible] to be a chloride of silver cell; if so, the [illegible] in a film of oxichloride of zinc being [illegible] the Zn, or perhaps all the silver chloride [illegible] reduced to metallic silver. In the former case [illegible] per cent. hydrochloric acid added to solution will effect a cure; if the latter, the remedy is [illegible].—P. WARD.

[illegible] — **Royal National Tricycle.**—If "[illegible] S." has fitted his key properly, and it should be made of steel, I cannot see why it should work loose. I take it for granted that it is a taper key, and the same width as the flat; but it would have been better to have been sunk in the axle slightly, as there is a great strain on any key. He does not require to keep taking his fast wheel off, as, if he does so very often, he will not keep all tight very long, and the axle does not require cleaning where it does not revolve; it is different with the loose wheel. Just ask some friend who is a fitter to have a look at it, and he will put it right very soon, unless it be botched to begin with. Do not be annoyed at plain speaking.—SECUNDUS HAUD ULLI.

[illegible]—**Bristol and Exeter Single Express.**—If "H. N." would be a little more explicit perhaps we could inform him. What engine does he refer to? What number? The B. and E. Co. has been defunct these six or seven years; but several of their broad-gauge single engines, now G. W. property, are still running.—W. B. P.

[52665.] **Water-Blower.**—If "Young Engineer" will purchase "A Handbook of Applied Mechanics," by Dr. Evers, published by Collins and Co., London and Glasgow, price 1s. 6d., he will find, besides the information desired (on page 181), a great deal of other information.—C. C. M.

[illegible] **L. B. and S. C. R. Engines.**—There are about [illegible] engines of the 194-200 class, same as 371 Norwood, &c., unless some more have been scrapped lately. Grosvenor is the only 6ft. 9in.; she is now numbered 326, and reckoned first of the [illegible] class, being practically of same dimensions. When first built in 1871 she was No. 151.—W. B. P.

[illegible] **L.C. and D. Engines.** There are six of the Constantine class viz. 127 Adrian, 128 Trajan, 129 Vespasian, 130 Tarquin, 131 Pertinax, 132 Constantine. They are built by John Fowler, Leeds, [illegible]. The Sharp Stewart goods are numbered 113 [illegible] inclusive, the names being Aris, Calypso, Diomede, Fortuna, Gordius, Pyramus [illegible] Aurora.

[illegible] **Continuous Steady Temperature.** [illegible] temperature for 72 hours continuously is a [illegible] matter to obtain. If the experiment is worth the cost, perhaps the best way is to use gas with a good pressure governor in the supply-pipe [illegible], and a second governor [illegible] to correct the errors of the first. With these a perfectly steady flame can be obtained under [illegible] pressures of gas, and it is only necessary to protect the flame and the substance to be heated from draughts. Good governors are [illegible] moderately good approximation to a steady [illegible] may be obtained by a common [illegible] lamp with a large flat reservoir, using [illegible] ordinary petroleum. This, if the flame is turned low enough not to smoke, will [illegible] half hour, give a flame which is practically steady for 12 to 14 hours without attention [illegible] lamp can be prepared so that a [illegible] every 12 hours. If a reservoir [illegible] the lamp, say, 7in. or 8in. [illegible] that there is little variation in the [illegible], and a first rate quality of [illegible] lamp will burn with perfect [illegible] 20 hours or longer, and the oil [illegible] without requiring a second [illegible] of the ends of the [illegible] with a penknife blade. [illegible] and be raised during the [illegible] half an hour after cleaning or [illegible] temperature must be watched, [illegible] by allowing the [illegible] substance to be heated and [illegible] petroleum lamp [illegible], of [illegible] high temperatures, [illegible] supply governed by [illegible] absolutely necessary; [illegible] lamp will do all which "Heat" [illegible] THOS. FLETCHER, [illegible]

[illegible] I cannot at [illegible] for replying to [illegible] some Derbyshire [illegible] for me. WM. [illegible]

[illegible] "Corporal" would find that washing them in warm soapsuds and water will clean them better than anything else; a little soda would also help. When well washed, rinse them out and hang up to dry. This is the way I treat mine, which I find are as good after a wash as new ones.—A. E. WEBBER.

[52677.]—**Casting Lead.**—If the lead is made hot enough, it will run easily.—NUN. DOR.

[52677.]—**Casting Lead.**—If "X. L. C. R." melts 1 part of antimony with 7 of lead, he will have a fine, soft metal, as used for large and soft type.—JOHN HALE, Univ. Coll., London.

[52677.]—**Casting Lead.**—"X. L. C. R." is not likely to find any material which can be mixed with lead to make it run easier. No metal is easier to run, to make good castings, and any addition is likely to make it worse rather than better.—T. FLETCHER, Warrington.

[52678.]—**Printing Inks.**—Boil linseed oil, stir well; set a crust of bread floating on the top, and apply a light (must be done in an extra large pot and in a safe place, not in the kitchen); let it burn for half an hour, but remove from fire; then add about 3lb. of rosin to every gallon of oil; and some add as much soap or more. Put on the fire and stir well. That's the varnish. Grind up the desired pigment in it with a muller, and there's the ink; but most people buy it ready ground and thin down with varnish.—NUN. DOR.

[52678.—**Printing Ink.**—Take some old linseed oil, and boil it in an iron pot with a rather tight-fitting cover. When it becomes inflammable, light it, and burn for ten minutes, then extinguish by putting on lid. Mix with it some black rosin. Then add some yellow rosin soap (if not added, the ink would accumulate on the face of the type), the proper proportion being found when the ink works clean. When cool, mix this oil with vegetable lampblack, forming a thick paste when finished by grinding very fine with a muller. Don't forget to boil the oil out of doors.—JOHN HALE, Univ. Coll., London.

[52678.]—**Printing Inks.**—The general mode of preparing these inks is by boiling linseed oil, setting fire to it, and allowing it to burn for about twenty minutes or half an hour. This produces a sticky varnish, which is very finely ground with the colouring matter required. Different manufacturers make various additions of their own, but of course, these are secrets. Here is an ink made from rosin oil: melt 1lb. of rosin oil and 13oz. of rosin, with 1¼oz. of soft soap. When it is cold, add the desired colouring matter. For other recipes, see my answers to queries 52182 and 52208, on p. 308, of No. 976.—W. HENLEY RICHMOND.

[52678.]—**Printing Inks.**—Black: Six quarts linseed oil, boiled till the vapours that rise will ignite, then it is taken off, and stirred with an iron spatula, and kept burning. When the oil has reached the consistence that it will draw out strings about half an inch long it is ready. The flame is then extinguished by putting a cover on it, and then 6lb. of amber or black resin is gradually stirred in, then 1¾lb. of dry turpentine soap, cautiously added. The pot is then replaced on the fire, and stirred till it boils: this completes the varnish. In an earthenware tub is placed 5oz. of Prussian blue, and 4lb. of mineral lampblack, and 3½lb. of good lampblack: to these the varnish, while warm, is added, and thoroughly mixed. The whole is passed through a levigating mill, which reduces it to impalpable fineness.—WALTER H. INCE.

[52683.]—**Bartolozzi.**—This exhibition was held in Saville-row, but I do not remember the number. It was almost the last house on the left-hand side.—JOHN HALE, Univ., Coll., London.

[52685.]—**Octave Coupler.**—I can only advise Mr. W. Ireland to seek an opportunity to examine an American organ in which an octave coupler is employed. This will give him a better idea than any amount of words can convey to him. I am not quite certain that an octave coupler can be applied to the harmonium successfully, and if the querist has never done anything of the kind before, I imagine that he will find it a somewhat difficult undertaking. You will find a short description of an octave coupler to the American organ in some of the back volumes; but you will not find it so convenient to apply the coupler to any harmonium unless the necessary arrangements for its application have been made previous to the arrangements of the other portions of its interior construction. If you wish to apply the coupler to any harmonium already completed, I should strongly advise you to discard the idea.—G. FRYER.

[52685.]—**Octave Coupler.**—If Mr. W. Ireland will tell me that the following pages cannot be referred to because the Nos. containing them are out of print, I will see what I can do to help him to make an octave coupler:—p. 435, Vol. XV.; pp. 145, 275, Vol. XXII.; or p. 436, Vol. XXIII. All that is necessary in making an octave coupler is 49 levers placed diagonally, and pinned at the centre on a rail which can be made to rise and fall. One end of these levers is in proximity to a screw put into the under side of a key; the other is attached by a flexible link to the pallet an octave above or below. Another simple arrangement (perhaps the best) is to bend some pieces of wire at the ends in the reverse direction, so that when one bent end is depressed, the wire revolving (in collars) opens the pallet, because that is attached to the other bent end or arm. In the first described coupler the levers may be either wood or metal. I prefer metal.—ORGANON.

[52689.]—**Gold Washing.**—I think "Washer" is mistaken in the use of the word "magnetism." Electricity is used for the purpose he names by a company called the Electro Amalgamator Company. The ore, or washings, as the case may be, are made into a paste and mixed with water, which is made to flow bodily over a long trough of mercury. The mercury is connected to the negative pole of a dynamo, or suitable battery, and the stream of water and ore to the P. The result is that the mercury readily dissolves all metallic particles contained in the flowing paste.—P. WARD.

[52694.]—**Furniture Cream.**—(1) Put 4oz. of soap and 1lb. of beeswax cut into thin pieces in one gallon of soft water. Having boiled the mixture well, add 2oz. of pearlash. When using, dilute it with water, and lay on with a paint brush, and lastly polish off with a hard brush or cloth. (2) Mix and heat together 6oz. of water, 2oz. of pearlash, and 3oz. of wax. Then add 5oz. of spirit of turpentine, and 4oz. of boiled oil.—W. HENLEY RICHMOND.

[52694.]—**White Furniture Cream.**—Here are three good recipes for it. 1. Yellow wax 4oz., yellow soap 2oz., water 50oz.; boil, with constant stirring, and add boiled oil 5oz., and oil of turpentine 5oz. 2. Soft water 1 gal., soap 4oz., shavings of white wax 1lb.: boil, and add pearlash 2oz. Lay this on with a paint brush (diluted with water), and then polish off with a hard brush or cloth. 3. Take of wax 3oz.; pearlash 2oz., and water 6oz. Heat together, and add boiled oil 4oz., and spirits of turpentine 5oz.—JOHN HALE, Univ. Coll., London.

[52697.]—**Damp-proof Glue.**—Good glue dissolved in spirits of wine will make a water-proof glue, as also will isinglass, with methylated spirit; a little heat will serve to melt in a gluepot.—A. E. WEBBER.

[52697.]—**Damp-proof Glue.**—I should think the glue referred to by Alex. Finlayson is the American fish glue, certainly wonderful stuff, and if he will advertise his address will send him the method of preparing it—costs nothing and is invaluable for persons using glue for any purpose.—ARCHITECTUS.

[52697.]—**Damp-Proof Glue.**—The glue which the "American" showed Mr. Finlayson was probably a mixture of 2oz. of unslaked lime-powder mixed with 4oz. of linseed oil, and boiled to a good stiff consistence. He can make waterproof glue by simply boiling 1lb. common glue in 2 pints of skimmed milk.—P. WARD.

[52698.]—**Gas for Boiler.**—Such a boiler as "Amateur Engineer" describes is extremely difficult to heat by gas to get any amount of work out of it. A gas burner is extremely liable to smother in a long horizontal tube, and no really satisfactory burner can be devised to work under such conditions unless it is supplied with a blast of air under pressure. It might be possible to devise a burner which would work under the conditions named, utilising the draught of the chimney; but such a burner would both need to be constructed specially, and would require some experience and knowledge to get it to work at all. It would be a very much simpler matter to use one or more burners underneath the outer shell. In such a boiler, externally fired, it would probably take 20 to 25 cubic feet of gas to evaporate 1gal. of water. The boiler is constructed to burn solid fuel, and is therefore totally unsuited for burning gas economically.—THOS. FLETCHER, Warrington.

[52700.]—**German Yeast.**—I should advise you to use Avant yeast, 2½lb. to 280lb. of flour. You need not be kept waiting at any time; sponging is not essential, ferment only. It would be ready for doughing from 30 to 90 minutes. As regards temperature, use your own discretion, according to weather. If you do not prefer this, and have had good results previous, all you require is extra plant.—CYPHER.

[52702.]—**Water Power.**—A pipe 9in. diam., head 1ft., length 400ft., will deliver roughly about 350 gallons per minute.—WATERMAN.

[52704].—**Piano.**—A modern action applied to an old cabinet piano would not be likely to produce very good results. As the present hammers show signs of hardening, rather than of cutting, I presume they are covered with leather; if so, it would greatly improve the tone, and take away the disagreeable metallic ring if a thin covering of felt were used instead. But, with a softer tone, many

other defects would become prominent, and he would probably find it necessary to cover the dampers, clothe the hammer centres, and renew the leather and parchment hinges throughout. The cost of all this would, if properly done, be certainly more than the piano would be worth when finished, so that in such a case it is very hard to advise. Should "E.," however, have plenty of time on his hands, and like to undertake the repair himself, I will do my best to help him.—W. H. DAVIES.

[52706.] — **Bottle Batteries.** — "Scrutator" will find that the most suitable battery for his 5-candle power lamp is a series of 10 or 12 bottle bichromate batteries, plates about 4in. by 6in. or 3in. by 8in., according as he can purchase them. There is a battery, which was a patent one, manufactured by Apps in the Strand, in which both carbon and zinc were raised at the same time. I have had one of these in use ten years, and, apart from occasionally having to renew the zinc, it is as good as new.—P. WARD.

[52707.]—**L. and S. W. R. Brakes.**—I am afraid H. W. Hudson must have been misinformed. Most engines on this line are fitted with steam brakes, but not automatic ones. The action of these steam brakes is entirely independent of the vacuum brakes on the trains, it being quite possible to use one without the other.—MACHINA.

[52708.]—**Stop for Photo Lens.**—I am not aware that there is any definite rule, the best position depending a good deal upon the construction of the lens. An extemporised stop fixed a little closer to the lens will remedy the defect complained of.—W. ROBINSON, JUN.

[52712.]—**Coupling Railway Waggons.**—If "Historian" can refer to the back vols., he will find several of these couplings, and a good deal about them; but, if he wants to know all, he must get a list of the specifications at the Patent Office (some hundreds). I don't think there is much chance of an automatic coupling being adopted under present arrangements, for there are obviously great difficulties in designing one that meets all the requirements, and when it is designed the railway managers would tell us they prefer the simple stick with a hook by which to lift the link and put it over the hook. Even where that is provided I don't think many of the men use it.—NUN. DOR.

[52715.]—**Steam Launch.**—An ordinary rowing boat would do if slightly altered. I do not think you would be able to go so fast as you mention; you might get 10 miles an hour, which would be a good speed for so small a boat. Further information I will give if you will advertise your address.—TIT BITS.

[52717.]—**Wollaston's Battery.**—I must inform our reader that his battery (which he thought was out of order) has nothing at all the matter with it; but simply the action which takes place in these form of batteries. Very great improvements have been made in the construction of the batteries, but still there is one decided inconvenience—viz., that after a short time they lose their power, which occasions them to act with a variable force during the same course of experiments. The zinc plates soon become covered with sulphate of zinc, and the copper plate with hydrogen, and even oxide of zinc. These deposits not only reduce the power of the battery very much when in use, but also require the plates to be cleaned, or renewed if worn away much, before they can be put into action again. In order to avoid these inconveniences, Bunsen, Grove, and Daniell have invented their constant batteries, where the porous partition, by which the principle of these batteries are constructed, without interrupting the conduction of the voltaic fluid, prevents the accumulation of depositions on the plates, or very little; for when a Grove's or other similar kind is put in action, the decomposition of the diluted acid does not attach itself to the platinum plate, but goes to change the nitric acid into nitrous acid, and the oxide of zinc remains in the diluted acid cells without penetrating to the platinum plate, which consequently remains perfectly clean; this circumstance essentially contributes to keep up the power and constancy of the battery, which renders it so valuable as a voltaic combination.—ELECTRICIAN.

[52718.]—**Dog Poisoning.**—Prussic acid or cyanide of potassium. Too virulent to be painful, and a very small dose sufficient—a few drops of the acid, a few grains of the cyanide. The assistant of any medical man would, I should think, settle the matter for a small fee.—NUN. DOR.

[52718.]—**Dog Poisoning.**—Mr. "C. H." would find that laudanum would have the desired effect—rather slow, but not much pain; a sort of sleepy stupor would come over the dog, and then he would die. For my own part, if I wanted to poison a dog I should use Prussic acid, about five drops on bread or sugar, or in milk, and pour it down, first chaining and securing him. Strychnine is another powerful drug; but should not prefer myself to use it, as it would require a larger dose.—A. E. WEBBER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last W. Robinson, jr., has replied to 52354, 52365, 52371; A. Gray, 52362; W. J. Grey, 52377-8.

52176. Light for Oxyhydrogen Microscope, p. 228.
52194. Finding Gravity of Light Fluids, 228.
52196. Becquerel's Oxygen Circuit, 228.
52202. Deed of Gift, 228.

52388. Warp Winding, p. 313.
52389. Sulphuric Acid, 313.
52391. The "Kewanee" Windmill, 313.
52399. Governors, 313.
52412. Painting Lantern Slides, 313.
52414. G.W.R., 313.
52416. Holding Links without String, 313.
52419. Memorial to Home Secretary, 313.
52429. Electrical, 314.
52430. Chemical, 314.
52436. Lachnanthes, 314.
52445. Legal, 314.

QUERIES.

[52725.] — **Long-Focus Telescope.** — My best thanks are due to "A Fellow of the Royal Astronomical Society" for his kind answer to my query. His courtesy encourages me to trespass still further on his good nature by putting a question, the answer to which will, I hope, come directly home to the point about which I am puzzled. We take an achromatic of 2in. aperture, and 30in. focus, bearing on a planet 120. The focus of eyepiece required to produce this result is ¼in. Now to double my power I apply an e.p. of ⅛in., but the resulting definition is unsatisfactory. Replace now the o.g. by another 2in., but of 60in. focus; and with the same e.p. as at first you get the magnifying power which you raised (but with unsatisfactory results) by the ⅛in. e.p. on the 30in. objective. Double the focus of your o.g. again, and with the same ¼in. e.p. that at first raised 120, you get 480. This is doubtless an extreme case; still it looks as if with a similar lengthening of the focus of common telescopes a gain could be effected in magnifying power, and (there being no costly increase of aperture) without the usual additional expense. The one great objection I see is the rule of "100 to the inch," but this is evidently not without its exceptions. I beg to assure "F.R.A.S." that my query is not put out of mere curiosity, but under the impression that if there is a substratum of truth in the above a door might be opened for increase of magnification without additional expense, which to the amateur with small means would be no trifling boon.—ARTHUR MEE.

[52726.]—**Fishing Flies.**—Are the feathers of the golden plover good for making flies? If so, from which part of the bird should they be taken, and at what time of the year might they be used? Also, what is the best sort of varnish for the heads of the flies?—SALVO JURE.

[52727.]—**Quantity of Water used per Hour, and Rule Wanted.**—Would any of "ours" give a simple rule of calculating quantity of water drawn from ⅜in. tap per hour? Pressure of water 40lb. sq. in. Also at 60lb. and 50lb.?—A. E. WEBBER.

[52728.]—**Deposit in Water Cistern.**—Living in a three-story house, the galvanised iron cistern on third floor is supplied from the town main by ball-tap. The hot-water galvanised iron cylinder is on second floor, and cast-iron boiler behind kitchen grate on ground floor. Now I would be much obliged if any of your correspondents can tell me the cause and remedy why the sides of the cistern, within a week after cleaning out, are covered with a soft red spotted rust, which, upon the slightest movement of the water—say running half off for bath,—becomes detached, and causes the water to be very muddy and unpalatable.—ENGINEER.

[52729.]—**Bronzing Mounts.**—Will one of our readers kindly inform me how the bronzing is done on card used for picture-frame mounts, as I cannot get the card already bronzed?—A. E. R.

[52730.]—**Legal.**—I have one of Clayton and Shuttleworth's portable engines, which I use for circular sawing. The piece of land on which it is erected is on a lease for about 76 years. It is about 23 yards from the street, and not near any houses, and the stack is a high one. The ground landlord says he will make me shift it—the landlord of adjoining property having taken offence, he saying it is an annoyance. Can you tell me whether a sawmill is considered a nuisance in law? The lease that I have forbids turning the property into a nuisance. I suppose the same is in every lease. Do you consider that he can compel me to shift it?—PORTABLE.

[52731.]—**Axle of Electrical Plate Machine.**—Will some practical reader of "ours" kindly furnish me, and others who need the information, with the details necessary to mount a glass plate 2ft. diameter, ¼in. thick, on a suitable axle? I have tried wood, but should like something better. The plate has a ¾in. hole in centre. Would a ¾in. rod of glass or ebonite be strong enough to stand the weight and strain? How are the bearings made, and of what material, and how are the caps to keep plate in centre cemented on? Why would not metal do?—the glass could not conduct the electricity to the axle. What length spark ought a machine of this size to give, constructed on Winter's principle, with 8in. ball for prime conductor, but without ring?—W. H. H.

[52732.]—**Permanganate Stain in Carpet.**—I should be glad if any one could inform me how to remove a large stain on Brussels carpet, caused by upsetting some of Condy's pure fluid. I have well washed with cold water; but the mark still remains—almost a black patch.—A CONSTANT READER.

[52733.]—**Finding Speed of Trains.**—I shall be pleased if some reader can tell me how many times Mr. Webb's new compound engines beat or "puff" to each turn of the driving-wheels, and whether the steam blast is as sharp or loud as in the ordinary single engines. I shall also be pleased to learn whether it is possible to find the speed at which at engine (non-compound) is travelling by noting the number of puffs the engine makes in a second? For instance: The steam-blast strikes the chimney-cap of an 8ft. driving-wheel engine between 11 and 12 times per second. At what speed does the engine travel? Can "Historian" oblige?—C. R. K.

[52734.]—**Paper Tubes.**—Will some kind reader give particulars of tools or machinery required for making paper tubes from ½ to 2in. diam., and from 6 to 18in. in length?—TUBES.

[52735.]—**Coloured Pencils.**—Will any reader inform me what is the colouring matter of the red and blue drawing pencils sold in the shops, and the method of preparing it?—ROUGE ET BLEU.

[52736.]—**Gelatine.**—Can any of your readers inform me if it is possible to make gelatine from ham rinds, or if the same is used in the manufacture thereof?—GELATINE.

[52737.]—**Steam Boiler.**—Will any reader who is a practical man tell me which is the safest and most durable form of steam boiler—the egg-ended shape, or the square end?—STEAM.

[52738.]—**To Fasten Fan Blades and Arms on Spindle.**—Would any reader give information for fixing six arms of fan on ½in diam. spindle? Arms of fan ¼in. diam.—SANDY SAM.

[52739.]—**Electric Bell.**—Will some electrical correspondent describe method of making electric bell to ring when a door is opened?—I want one that will only ring for a short time, and then stop—whether the door is left open or shut. Also good form of battery, with some substitute for usual earthenware porous cell.—CHEMICUS.

[52740.]—**Drying Damp Room.**—I should be glad if any one could tell me a means of drying a damp room, which has no fireplace in it. There is a good deal of gas burnt in it, which probably increases its natural dampness. It would be very inconvenient to place a stove in it, as the room is a small one, which is plenty warm enough without one. I have a lot of books in the room which I am afraid are being damaged by the damp. Is it possible to dry the part surrounding the bookshelves (which are not cased in), without bothering about the rest of the room?—C. J. N.

[52741.]—**Aneroid Barometer.**—I have a small pocket aneroid barometer which was accidentally let fall about six weeks ago. Since that time the index hand has remained at the same point. Is it possible for me to put it into working order again myself, or had I better send it to a professional?—C. J. N.

[52742.]—**Upright Tool.**—I have a watchmaker's English upright tool with the ordinary hand-rest. I wish to put a slide-rest on. Could any one tell me how to do it, showing a description of the same?—R.

[52743.]—**Lathe Saddle.**—Will "J. H." kindly inform me how to make a pattern for the above?—O.

[52744.]—**Marble.**—Will any of our kind readers tell me how to get bichloride of mercury stains out of white marble, and also iron stains?—E. BEAUMONT.

[52745.]—**Furnace.**—Will any reader instruct me how to make a small hollow fire or furnace, say to weld about 2in. square iron for light edge tool? I have a pair of 38in. bellows going by water power. Would that give sufficient blast? I have tried one, and that would not answer my purpose. The iron seems to melt off and wasting, and when I took it under my hammer the steel would fly in all directions, and would not weld. It was full of blisters, or some parts unwelded. Raw coal I used. Would a fan answer the purpose better than a bellows?—UNSUCCESSFUL.

[52746.]—**"Edco" Battery.**—Can any one add to the interesting account given of this battery by stating the amount of candle-power of incandescent lamp sustained by the two-cell battery for 90 hours?—DELTA.

[52747.]—**Electric Microscope.**—Can any reader kindly explain how this is worked? An exhibition of it was given, according to daily papers, on Saturday, Jan. 5, at the Crystal Palace, Sydenham.—DELTA.

[52748.]—**Railway Truck Springs.**—Will some reader oblige me with some information as to making and tempering truck springs? I have some to make.—A BLACKSMITH.

[52749.]—**Lime Green.**—Can any reader mention a good green colour which will stand when used with lime? Also a yellow, brighter than ochre, for the same purpose.—W. D. B., Dublin.

[52750.]—**The new "Edco" Battery.**—Can any reader say what is the object of having lead cells? Also are they united? Are the carbons insulated from the lead cells?—H. R.

[52751.]—**Recovering Silver.**—Would "Os," or any other, kindly say the best and cheapest way to recover the silver from bits of iron about 1in. long, ¼in. square, which have been electroplated? They are cropped from articles we have to mount, and are thrown away with the rubbish as no use. Would some one send a practical answer, and oblige a—SHEFFIELD WORKMAN.

[52752.]—**Clock to Strike by Electricity.**—I have a clock in distant part of house that strikes half-hours and hours. I should like to make a single-stroke electric bell strike same as clock. Can any of our able correspondents give me instructions, with sketch? Also, I have several clocks that I should like to regulate by same clock (marble, French eight-day). Will "Sigma" or Mr. Lancaster help me? At Town Hall, Shoreditch, I see hall clock is regulated by the Standard Time and Telephone Co. Can any one oblige with sketch of their system?—CLOCK.

[52753.]—**Copper Ores.**—Would some correspondent kindly furnish information to analyse copper ores by means of the galvanic battery, stating description and number of cells required?—X.

[527[illegible]]—**Japanese Scintellettes.**—Can any of your readers tell me how these are made—viz., what is the composition?—SHAKESPEAR, Dresden.

[527[illegible]]—**Lathe Bed.**—I am much obliged to "J.H." for the trouble he has taken about my bed pattern. I have been making inquiries at the foundries, and I find they object strongly to a cored gap. Can the gap be left out in the pattern without altering the core-boxes? How do the core-boxes open? The founders here are very fussy, and make much ado about little things that would be thought nothing of in England.—SHAKESPEARE, Dresden.

[52756.]—**Agriculture.**—Can any of your readers inform me where I can learn anything of the system or works of a Mr. George Reed (?), who made experiments under the Emperor Napoleon III., relative to the raising of cereals and the fertilising of barren sandy soils through chemical agencies—in both of which he was remarkably successful?—B. M.

[52757.]—**Silvering Solution.**—Please inform me if potassium cyanide argento (otherwise silver solution) will leave a deposit of silver on base metal, and if so, which will be the best way to apply it?—J. HALES.

[52758.]—**Speed Regulator.**—Can any one give particulars of the vibrator which regulates speed in Hughes' type-printing telegraph or any kindred form of vibrating regulator?—COSMOS.

[52759.]—**Deer's Head.**—Can any fellow-reader inform me how to remove the hair from an old deer's head without destroying the skin. Any information will be thankfully received by—INQUIRER.

[52760.]—**Safety Valves.**—Will any of "ours" inform me of the proper mode of adjusting safety valves? I want to adjust a valve to a boiler of 40lb. pressure. What proceeding must I take to have the valve properly adjusted?—PHONOGRAPHER.

[52761.]—**Phthisis.**—Having suffered for about four years with painful congestion of the right lung, accompanied by dyspepsia and much opaque expectoration, I should be very glad if some kind medical reader would prescribe me a remedy? I have tried cod liver oil, but cannot digest it. My age is 24, and able to work at my trade, which is not hard, being a sitting occupation.—M[illegible].

[52762.]—**Hens losing Feathers.**—I shall be obliged if any of your correspondents can tell me what ails my hens? A number of them have lost the feathers around the neck, and they have remained so all winter—some of them from last winter. Others are bare of feathers just in front of the neck. I have fed them twice a day on Indian meal "crowdy," as they call it here. They have any amount of field run, but rather a small wooden house to roost in. Any suggestions about their proper treatment and feeding will much oblige.—W. A. H[illegible].

[527[illegible]]—**Violin Measurements.**—Will any of our kind readers recommend to me a work (book) on the history and mystery of the violin, or give me the correct lengths of the strings from nut to bridge on a quarter, half, three-quarters, and full size instrument?—R. G. [illegible]

[illegible]—**M'Naughted Engines.**—Will any correspondent tell me what is meant by engines being M'Naughted? Also, what is a [illegible] valve, and what is the [illegible] and advantage, if any, over the ordinary slide valve?—W. [illegible]

[illegible]—**Prevention against Sparking in Electrical Contact Makers.**—Can Mr. Sprague, Mr. [illegible], "Sigma," "Electrician," or any of your readers versed in the subject, give me information to enable me to prevent sparking, and consequently fusion, of the platinum contacts in the make-and-break connection in an electrical apparatus I have. I may say the current I employ is generated from a battery of eight cells [illegible], coupled in simple series, and my electro-magnets [illegible] similar to those usually employed in electric bells. After some little time I find that the push contacts faced with platinum show signs of being badly [illegible] owing to the sparking at these points. What is the best means of [illegible] this?—[illegible]

[illegible]—**Magic Lanterns.**—I am desirous of purchasing [illegible] with refulgent lamps [illegible]. Will the [illegible] form of lantern [illegible] with this light? What is the [illegible] dissolving view slides register[illegible] It is here premised that [illegible] W.

[illegible]—**Lathe Bearings.**—Will some kind reader [illegible] of conical bearings for [illegible] explain how the wear is taken up?—A. [illegible]

[illegible]—**[illegible] Engines.**—I hear woeful [illegible] coupled engines (707 [illegible] Co., on the ground [illegible] differ in details from [illegible]

[illegible]—**Dynamo.**—[illegible] How many [illegible] supply if made twice the [illegible]? Will everything have to [illegible]?—H. H. W.

[illegible]—**[illegible] Clock.**—I have one of [illegible]. It will [illegible] and the rack [illegible] weight, [illegible] What is likely to be the cause? [illegible]

[illegible]—**Wimshurst's Influence Machine.**—[illegible] good enough to publish a [illegible] in reference to this [illegible] in combination with the [illegible] more than justifies all [illegible] as nearly as pos[illegible] as I got from the [illegible], but the spark [illegible] with the one, [illegible] with the other. How [illegible] (24), or therefore the distances between the sectors, or between the sectors and the bulb, are too short for proper insulation? Will some of your readers please enlighten me?—STUDENT.

[52772.]—**Tinning Bright Steel Goods.**—Will some kind reader put me right in the following? Having a quantity of bright steel goods to tin, I have tried the following solution: Dissolve 17½oz. of ammoniacal alum in 22lb. boiling water, and when dissolved add 1oz. protochloride of tin. The articles having first been coppered, are immersed in boiling solution. The result: a good deposit of tin, but very dull, except in one instance only they came out bright; but I have not been able to obtain the like result since. It is absolutely necessary the articles should be bright. Information as to the means by which I can effect this will greatly oblige.—I. P. R.

[52773.]—**Waterwheel.**—Will any reader tell me whether I could use a waterwheel under the following circumstances, and work a double-action lift-pump 5in. barrel, about 16in. stroke, with a small engine? I raise the water, say, 5ft. above the level of the ground. What I want to know is—Can the water be utilised in such a way as to assist the engine in pumping itself out of the pit? I can get a greater fall if necessary.—NARVA.

[52774.]—**Strabismus.**—To "S. M. P."—Many thanks for last reply. Would you kindly say how is electricity applied to the muscle of the eye in such case? Querist does not intend to apply it himself; but it would be an advantage to have an intelligent idea of the matter before proceeding further. Spectacles tried with little benefit.—EGO.

[52775.]—**Dynamo.**—To MR. S. R. BOTTONE.—I am making a dynamo half as large again as your instructions. Will you please give size and quantity of wire for use for lighting incandescent lamps, and what might I expect from it if driven by lathe?—J. R. C.

[52776.]—**Dynamo.**—Will Mr Bottone or some of my fellow-readers kindly oblige with the working drawings and full instructions for making a dynamo capable of generating current for three or four hours daily equal to 10-c.p. Swan incandescent lamps? How many horse-power will it take to work it at ordinary speed? I propose working it by a turbine, as I have the water at hand.—JOHN HALE, Univ. Coll., London.

[52777.]—**Water Turbine for Dynamo.**—Will some of my fellow-readers kindly oblige by giving working drawing for making a turbine capable of turning a 500 c.p. dynamo at ordinary speed? Kindly also state how much fall and diameter of leaden pipe it would require to drive it?—JOHN HALE, Univ. Coll., London.

[52778.]—**Dissolving Views—Registration of Effect Slides.**—Can any reader give me a good plan for the registration of effect slides? I have a bi-unial lantern, but find it difficult to get effect exact in its place. Take, for instance, view of church, effect of windows illuminated. Unless the window of view and window of effect exactly coincide, the picture is spoiled. I have tried several plans of my own, but not with the success I should wish. Any-one who has seen Mr. Malden's exhibition knows with what precision his effects are worked. Perhaps one of "ours" can give me his plan; or for any other I shall be thankful. I may add I use all sizes and thicknesses of slides, from a comic movable to a thick chromatrope.—FRED.

[52779.]—**Burning Clay.**—I have two or three fields of very stiff clay, and I want to give them a dressing of fifty or sixty yards of burnt clay to the acre. Now, I should feel obliged if any of your readers could give me a hint as to the best way to burn it, my fuel being furze bushes, faggots, and roots. A year or two back I got a couple of hands accustomed to burn ballast for the railways; but, notwithstanding my endeavours, I could not prevent them overburning it, rendering the product unfit for its purpose—that is, the amelioration of the soil. What is wanted is not a hard red lump, but the clay so burnt that it crumbles to dust between the finger and thumb, and when powdered and wetted does not again become plastic. I have heard that in the northern parts of Essex and borders of Cambridgeshire there are men who make a trade of burning clay for manurial purposes.—KHODA BUX.

[52780.]—**Bath Heater.**—Will some of your readers kindly inform me the best kind of bath heater? I have tried a variety, including Fletcher's copper tank with gauze burner, and also one of Sugg's patent "Therma's" with 20 gas jets; but even with the latter am unable to get the temperature up to 98° for a warm bath of 40 gallons in less time than 1½ hour.—J. H. HUMPHRISS.

[52781.]—**Battery for Lamp.**—In looking over some back numbers I came across, in Vol. XXXVII. No. 946, a description of a granule carbon battery by "E. F. F.," which I resolved to try, using jars of the following dimensions: Outer jar, 6in. by 4in.; porous jars, 6in. by 2in.; zinc, 6in. by 1½in.; carbon, 6in. by 1in. square. I constructed ten of these, and obtained a light equal to about 1½ candle with a 5-candle lamp, and, after working 6 hours, diminished to a dull red heat. Next evening I took out the zincs and gave them a thorough cleaning, after which I again obtained a light as before, but this time only 2 hours. Where is the fault? I am about to construct some larger cells. Am I liable to have the same trouble with larger ones? I use sal-ammoniac and hydrochloric acid for porous cell. 2nd. Thanks to P. Ward for his answer to former query. I had discovered my error before his answer reached me.—ROBERT S. HARGREAVES.

[52782.]—**Dynamo.**—Would Mr. Bottone, or any other electrical friend, kindly suggest a remedy for the better working of my dynamo? It has double-field magnets and Siemens armature. I excite the field-magnets with a three-cell bichromate battery, and get a lot of sparking at the brushes; but it will not come away from there. It will not red a five-candle lamp, though I have 7lb. 16 wire on each (4) pole of magnet, and 4lb. 20 on armature. I do not seem to get sufficient magnetism in the field-magnets.—WAG.

[52783.]—**Phenylendiamine.**—To MR. WM. JOHN GREY. Will you kindly inform me how to separate this base from tin, iron, or zinc chlorides?—DIPHENYL.

[52784.]—**Pedal Reeds to Harmonium.**—To MR. FRYER.—I have constructed pedals and bellows to attach to my four-row reed harmonium, as suggested by you some months ago. Will you kindly instruct me how to make the pan? There will be sufficient wind for two sets of reeds—viz., 16ft. and 8ft., which I have by me—1½ octave each. What proportion in length and size should each tube be for its reed?—STATION-MASTER.

[52785.]—**Hughes' Battery.**—Can any one tell me what is the E.M.F. and internal resistance of Hughes' sulphate gravity battery as used for microphones? Would reducing the thickness of sawdust materially diminish the internal resistance? Are three or four of these cells suitable for working a small medical coil consisting of five layers of primary coil?—BATTERY.

[52786.]—**Tricycle Crank.**—I am about to have a tricycle built for me. Having a particularly long leg, would it not be advantageous for me to have a crank with a little greater than ordinary throw? The mechanical advantage of (say) another inch to the crank would be very great, while the tread to my long leg would be nothing more than comfortable. This has no reference to raising the saddle, which is quite another matter. I should state that all my riding will be at easy speed—no racing.—J. K. T.

[52787.]—**Boiler Query.**—Would any of your mechanical readers suggest a remedy for the following?—A steam boiler working at 60lb. pressure, manhole door joints made with hempen rope, and red and white lead; blows every three or four weeks, and has to be remade. It used to go for months before; have had it thoroughly examined by boiler makers, and still the same. I would be glad if some one would give me their advice upon the cause, and how to remedy it.—A. G.

[52788.]—**Papier Mache Ornaments.**—What is mixed with the pulp? Can I make it thin enough to run in like plaster of Paris? Should the moulds be of wood or metal? How long before the castings are dry enough to use?—SAMPSON.

[52789.]—**Watch Repairing.**—Geneva watch stops at times. It is in beat, and every part is clean and free of action, but when going the balance has a bad swing, causing teeth of escape to ride on edge of cylinder instead of sounding sharp and clear. It has the sound of click similar to feeble beat of a lever. If any reader will kindly inform me how to alter the depth I shall feel greatly obliged.—W. R.

[52790.]—**Rotary Hook for Sewing Machine.**—Will some practical hand give a few diagrams and details of the best form of hook, spool, and spool holder, showing how the two threads are to be related, so as to enable a mechanic to make and fit up a machine of this kind.—LOCK STITCH.

[52791.]—**Indiarubber Gas Tube.**—I am using some black rubber tubing to connect a gas stove with iron pipe. The tubing gives off so strong an odour that one can scarcely believe but that the gas escapes. The odour is not diminished when the gas is turned off. Can any reader tell me if I can coat the tubing with any substance so as to remedy the evil?—E. EDWARDS.

[52792.]—**Steam Launch.**—I am desirous of making, or, if the task be too formidable, of having made, as small a steam launch, for river use, as is possible, compatable with quite safely carrying three, or at most four, people (one of whom would attend to engine), the weight of engine and boiler, say 1cwt. coals, usual boat gear, and usual camping-out requisites, which latter would be very simple and limited in quantity as much as possible. In addition to the foregoing an extra carrying or supporting power (buoyancy) would have to be allowed for, to provide for light contingencies and a very liberal margin of safety. There ought to be no danger of the boat turning over when the occupants move about in it, provided they are reasonably careful when doing so. There would be no cabin accommodation or other protection from the weather, except such as would be afforded by a waterproof canvas covering rigged up on light movable iron rods. The boat is intended to be used purely for pleasure purposes, short excursions, camping out, &c., and as it may be just the kind of boat that other amateurs, living, like myself, near a river, would like to possess, and whose requirements in this way are not ambitious, and possibly restricted by the pocket, I trust this query may be of general interest, and that fellow-readers will give me the benefit of their knowledge and experience. Would a boat 12ft. long from stem to sternpost (which latter is, I think, the name of the timber in which stern bush is fixed) be long enough, with say a beam of 4ft., and of such depth as would be necessary (there being no restriction as to draught), including a good freeboard? The total length of boat, including the counter or projecting part over screw and rudder, would possibly amount to 15ft. or so. May I solicit opinions on this point? Also, what should be dimensions of smallest cylinder capable of driving the requisite sized and loaded boat, eight or ten miles an hour, at a pressure of (say) 30lb., or at such pressure as would be recommended? Are there any books published on steam launch building for amateurs? and would it be preferable for me to have the hull built by a professional boatbuilder rather than attempt it myself? I am quite confident about making everything connected with the engine, and, with the help of a carpenter, feel sure I could build the hull if there is no special difficulty in it. What would be probable cost of engine and boat complete? I should be grateful for any hints on this subject.—H. H. H.

[52793.]—**Wall Fillings.**—I should feel greatly obliged if any reader would give me a rough sketch of some scheme for temporary fillings to two corresponding wall spaces in the east end of a church—something inexpensive that any one with an artistic turn of mind could do. Size of wall spaces about 12ft. by 8ft.—CHURCHWARDEN.

[52794.]—**Toning Prints.**—Will a photographic subscriber tell me how I can tone dry-plate prints so as to get out the red colour? I print them till they become a purple black.—VANGO.

[52795.]—**Extracting Alcohol from Oil.**—A few months back I read in "ours" of an experiment by which the alcohol in oils could be extracted, water being the chief power. Would some kind reader give again the details of this experiment, and also please say whether the oil thus freed is improved for lubricating or other purposes?—YOUNG OILMAN.

[52796.]—**Income-tax.**—I have property in New Zealand, on which I pay the usual taxes, including property tax. Am I legally bound to pay Income-tax on the portion of my income (£400) spent in this country?—COLONIST.

[52797.]—**Joining Electric Wires.**—In an article in the *Engineer* of the 12th inst., it is said that soldering electric wires is not necessary, and electricians do not know how to make a good contact without it. "Engineers will be happy to teach them," says this oracle; but it carefully omits to say how to do it. Therefore, I appeal to the readers of the ENGLISH MECHANIC, who are ever ready to help one another, to reply to the question. What is this method of joining wires which will answer as well as soldering?—S. M.

[52798.]—**Lalande's Voltaic Element.**—Can Mr. Sprague, or any of your electrical readers, give a brief description of the new Voltaic element of Lalande?—P. W. R. H.

CHESS.

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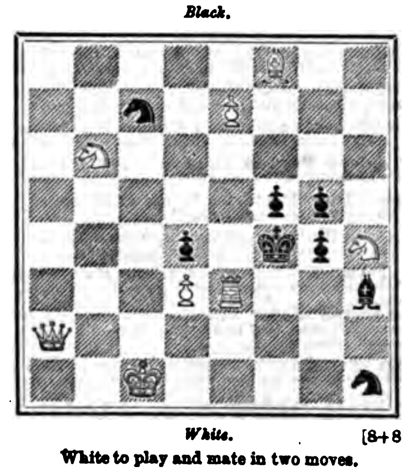
ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXX.—By R. CRUESEMANN.

Black.



White. [8+8

White to play and mate in two moves.

SOLUTION TO 868.

White.	*Black.*
1. Kt from Q 8 to K B 4	1. Anything

(10 variations.)

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 867 by Dicky Sam, J. B. of Boxford (clever problem), E. Stanley Follwell; to 868 by Dicky Sam, J. B. of Boxford, A. Schmucke, E. S. Follwell (very neat), R. A. Bennett, J. G. E. (Sittingbourne), D. Millar, W. H. Evans, Rev. W. Anderson.

D. MILLAR.—Solutions must be sent within a fortnight after publication of problem.

A. C. HURLEY.—No mate if 1. $\frac{\quad}{\text{Q to B 4}}$

F. WEST.—The variations must be sent in full; otherwise marks not allowed. Where is the mate if 1. $\frac{\quad}{\text{P-Q 4}}$?

H. NEWMAN.—Look again at 867: you will see that Black can escape.

Boldo is the name of a plant indigenous to Chili. The leaves serve to make two preparations—viz., a tincture and a fluid extract. These fluids are prescribed in America for cases of adynamia and to strengthen the action of a feeble heart. An essential oil is contained in the leaves, which seems to exert a modifying influence on inflamed mucous membranes. Recent observations made by M. Verne seems to show that the quantity of urea discharged by the kidneys is increased without any change in the amount of urine excreted. Aromatic principles have been detected in the urine. The body heat and circulation are unaffected by these preparations.

THE greatest elevation that the Pike's Peak Railway will reach will be 14,146ft., making it by 2,000ft. the highest railway in the world. It is to be 27 miles long, with a maximum gradient of 300ft. in the mile, and maximum curves of 30 deg. It will be narrow gauge, and the trains will be composed of three carriages, each carrying forty passengers. The line is being laid out with a view to scenery, so as to command the finest possible views of the magnificent scenery of the Rocky Mountains, and open up attractive sites for hotels, sanataria, and camping grounds for summer tourists.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 16, and unacknowledged elsewhere:—

E. HOTHAM.—L. Von Malein.—J. K. Esdaile.—W. Erck.—R. McCowen and Sons.—C. E. Miles.—W. P. Kelly.—J. S. Purvis.—E. P. Alexander.—Beeching and Goose.—E. F. Hitchin.—R. Pattison.—Historian.—Feed Pump.—Harry Bhill.—Lecturer's Assistant.—R. Stafford.—S. G. Bryant.—Gas Lamp.—Brine.—Ditton.—Saint Rollox.—Garm-Hawa.—E. Hall.—W.—American Organ.—R. A.—Engineer Jack.—S. Bottone.—T. G. Elger.—Bossi.—H. A. Wassell.—J. H.—W. F. Denning.—W. G. P.

A. B. (You will most likely get nitrate of soda of dealers in chemical manures in Dublin, or of drysalters. It is sometimes called cubic petre. If not, those who advertise chemicals in our columns would no doubt supply you. The nitrate of potash or saltpetre ought to be as efficient for your purpose.)—CLERK. (See list of Back Numbers on Copying Processes. One kind is made of glue 1, glycerine 4, whiting to colour, and water sufficient.)—BROTHER STIGGINS. (There is the telegraph service, electrical engineering, and electro-metallurgy.)—ALFRED WATKINS. (The price will depend on what the law stationers like to charge; but we believe that a complete set costs about a shilling.)—MECHANIC. (We cannot give any further advice. Better consult a medical man. All that can be said without seeing you you will find in Vol. XXXIV.)—ANOTHER AMATEUR DADDY. (You will find papers on boot and shoemaking in Vol. XXXVI. pp. 112, 116, 137, 160, 186, 206, 227.)—DOUGLAS. (You will find the information required on p. v. of the number for Jan. 4 last!)—ACIER. (It is said that nitric acid will produce a black spot if dropped on steel—the darker the spot the harder the steel. If dropped on bright iron the metal remains bright.)—X. Y. Z. (The *Transactions* of the Institution of Naval Architects are sold by Sotheran and Co., 36, Piccadilly, W.; but the office of the Institution is 5, Adelphi-terrace, W.C. With regard to the other matter, if you refer to p. 365, Vol. XII., you will find a review of "The Life of Isambard Kingdom Brunel," by Isambard Brunel, published by Longmans in 1870. Your bookseller has misled you. It is useless to specify any date for an answer to appear. As a matter of fact, the number for the 11th was half-printed when your letter reached us.)—COMPARISON. (A query of a similar kind was inserted on p. 331, No. 52481. The Insulite Battery was illustrated on p. 282, last volume.)—G. H. M. (Unless you say what sort of an alarum you require, we can only refer you to the indices. We have given quite a variety. You will want a battery and a bell, and presumably a clock, if it is to wake you up in the morning; but if that is so, why have an electric alarum?)—LITHO. (Both indiarubber and guttapercha solutions are made by dissolving in either bisulphide of carbon or mineral naphtha. The sample sent is guttapercha tissue, largely used by artificial flower makers for wrapping round the stems. That is not produced by a solution.)—DURHAM. (We do not know of such a book; all that can possibly be written about it would not make more than, say, a couple of our pages. You will find all necessary information on pp. 36, 238, Vol. XXXIV. 2. There is a paper called *Hardware*, price 4d., published by W. Leicester, 29, Bow-lane, E.C.)—ESSENTIAL OILS. (Any manufacturer of such apparatus would show you the most suitable still. Fairly complete directions in such books as Ure's Dictionary. You know, we presume, that success can be attained only when they are prepared on the large scale.)—F. SHAW. (The wet; but opinions differ. You can judge for yourself by studying the illustrated descriptions given on p. 466, Vol. XXIX. (wet), and p. 338, Vol. XXX. (dry). The wet meter is liable to freezing.)—WIRRY. (It is impossible to understand, from your account of where the ends of the wires come, what is your difficulty; but all that you need attend to is to see that the wire coils in one direction. Coil some string round a piece of cane, and then bend it to represent the two poles, and you will see at once. The ends can be where you like.)—DR. E. H. BRICKELL. (We think you cannot compel the purchaser to complete the bargain, as no time limit was named, although if your account of the transaction is correct, you have been unfairly treated.)—PRUDENCE. (Yes, if the premises are not damaged by their removal.) B. (1. Must ask through the "Address" column. 2. You are liable for the duty.)—W. L. LANCASTER. (We regret to seem disobliging, but really cannot engrave blocks merely that the individual querist may know whether his observation of the positions of the satellites was a correct one. The positions might have been stated without a sketch.)—TEN YEARS' CONSTANT READER. (Clockwork would, we think, be best, because of the uncertainty attending electricity, which, in your case, would be awkward if the stoppage were ever so temporary. Any clockmaker would devise a plan, but we cannot recommend one here. A sixpenny advt. in the "Wanted" column would probably place you in communication with one.)—T. J. O'CONNOR. (We have not seen the book.)—ENGINEER. (You can sue them at your local county-court; you will only have to state the circumstances to the registrar and obtain his permission to issue the summons. Issue a summons "under Section 1," and you will, we expect, quickly get your goods or your money returned.)—CYPHER. (We do not think you could patent such a thing, and if you could, we do not see how you could enforce it. You could, of course, appoint an agent as you suggest; but what is to prevent him making a similar bread, and selling it without paying you royalty?)—W. B. (As it is so persistent, it must be some kind of skin disease—as a rule, very troublesome complaints. From your description it would seem to be advisable to try change of diet, exercise in the fresh air, and anything likely to increase the strength.)—W. B. (There are machines of the kind, but they are little known out of the factories. Try some of those machinists who lay themselves out for work of the kind, or, if that is impossible, send a more definite query, saying exactly what is meant.)—RAYMOND JONES. (You must have a frame of either wood, zinc, or iron, and preferably a slate bottom. A variety of recipes for cements on pp. 459, 481, 599, 623, Vol. XXXIII. 2. Most likely they have been killed by damp or cold, as they require to be kept growing on. It is only the old plants which will stand frame treatment.)—DE MCGLASGOW. (The usual plan is to rub a coloured powder through the perforations. The pad you refer to was no doubt supplied with aniline ink, like those used for rubber stamps. Look up the subject in back volumes.)—JOHN ROBERTS. (You will find an article on the subject in Vol. XXXI., p. 57, and others in previous volumes.)—CHEMICUS. (Several motors of the kind described in back numbers, and series of papers on the subject now in course of issue. Look up the indices, and then you can select the one you think will suit you best.)—H. B. (You should have used gas tar and lime, not Stockholm. If chimney gets red hot, nothing stands well, but perhaps blacklead mixed with stale beer looks best and lasts longest.)—O. H. M. (What speed do you expect to get? The arrangement proposed would do as well as anything else; but see what has been said in back numbers about electric launches.)—WAYMAN. (If recent, try oil of turpentine, fuller's earth, or even strong solution of soda. If old, make a paste of fuller's earth and soft soap, with a little turpentine and lay on; but as a rule they can generally be removed with pieces of blotting paper and a warm iron.)—UNEMPLOYED. (The actual knowledge required is very small; but some little practice is necessary. Both men and women are employed.)—C. R. (See p. 118, Vol. XXXIV.; p. 544, Vol. XXXIII.; and the indices generally.)—H. F. H. (The stone must be roughed down with a chisel, or, if round, with a tool in the lathe. It is then brought to a smooth surface with sand or emery and water, using wood rubbers, and then polished with tripoli, &c.)—JOHN A. REKOE. (See p. 580, last volume, and many other places in recent volumes. There are several processes and many little secrets.)—MASSEY BROWN. (For frosting tin, see pp. 202, 225, this volume.)—PHOTO. (See pp. 490, 513, Vol. XXXII.; but the process is given in all the handbooks. 2. The best developer is usually given by the makers of dry-plates; but you will find one suitable in some of the back numbers.)—AMATEUR. (It would not be an advantage, because that metal rapidly loses all magnetism.)—SUBSCRIBER. (The best anti-incrustant depends on the nature of the water. Try common washing soda. See p. 114 last volume, and pp. 215, 261, this volume. About ½lb. of soda put into feed-water would be a sufficient daily dose for such a boiler, even if the water contains much carbonate of lime.)—ARIEL. (Mr. Fletcher, Warrington, makes just the sort of furnace you require; but what is meant by "iron, &c."? However, see his catalogue.)—NO NAME, Derby. (No, not with plenty of practice. 2. They may be described as half-round valves, revolving in passages instead of sliding over seats. 3. It is a matter of opinion.)—IMPUDENT TELEGRAPHIST. (If "cement" was mentioned, no doubt electrical cement was meant—viz., rosin 5 parts, beeswax 1 part, and red ochre or Venetian red 1 part. Some add plaster of paris or whiting.)—JNO. PARSONS. (The description is not sufficiently technical.)—DR. E. S. HABEL, St. Louis. (For the present, further particulars must be looked for in Specifications Nos. 5122, of 1882, and 1639, of 1883.)—C. MATHERY. (You do not give us any clue to the previous answer, nor even state what numbers were wanted, nor the subject on which information is required. If the numbers are out of print, a query is usually inserted. The list referred to is inserted the first week in each month, or "at intervals," as plainly stated in its heading.)—W. ROBERTSON. (The lower end of a barometer tube is immersed in a small cistern of mercury, and is not "sealed airtight." Consequently, the height of the column of mercury is a measure of the pressure of the atmosphere.)—W. J. L. (See p. 256, No. 789. It is a patent, and you would find full details of all the processes at the Patent Office Library, if you cannot refer to our back volumes.)—STRATHEDEN. (Probably some of the lenses have shifted; but it needs examination to point out the remedy.)—AMATEUR MOULDER. (You will find two brass melting furnaces on pp. 120, 240, Vol. XXXIV., and several others in back volumes. If you have gas, procure Mr. Fletcher's catalogue from Museum-street, Warrington.)—M. H. D. (There is no book that gives such details as you require. You will find them in a series of articles in these pages, and also in back numbers.)—V. DE V. (No examination is necessary to enable you to call yourself "C.E." There are examinations held by the Institution of Surveyors, Great George-street, S.W. The secretary would probably send particulars on application. Twelve months in a good London office is what you want; books will be of little use; but some good and cheap manuals are published by Lockwood and Co., 7, Stationers' Hall-court, E.C.)—R. A. BENNETT. (Impracticable; the number sold would not pay. You probably forget that a very small minority, comparatively speaking, have a *complete* set.)

[illegible]

[illegible] Horizontal [illegible]

[illegible] Design and Work [illegible]

[illegible] Gold Albert [illegible]

[illegible] Photographic Camera [illegible]

[illegible] Boiler. [illegible]

[illegible] Steam Engine [illegible]

[illegible] Amateur [illegible]

[illegible] Lantern Slides. [illegible]

[illegible] Engine. [illegible]

[illegible] Amateur Work [illegible]

[illegible] Microscopic Slides or Accessories [illegible]

[illegible] Knowledge [illegible]

[illegible] Imperial Shakespeare [illegible]

[illegible] Bicycle. [illegible]

[illegible] Telescope [illegible]

[illegible] Slides [illegible]

[illegible] Apparatus [illegible]

[illegible] Foot Lathe [illegible]

Pressure Gauge, by Hayward, Tyler, and Co. [illegible] — [illegible] Stafford.

Fret Cutting Machine, new, with counter [illegible]

Wanted, a **Lithographic Press** [illegible]

Wood Turner's **Lathe**, [illegible] Carpenter's [illegible] Wolverhampton.

Steelyards, by Avery, [illegible] Capital [illegible] exchange. — Apply [illegible] Wolverhampton.

Bassoon, six keys, in good playing condition. Exchange [illegible]

THE SIXPENNY SALE COLUMN

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Transit Instrument, for obtaining accurate time [illegible] — [illegible] Westminster Chambers, London.

Music — [illegible] worth of best sheet music [illegible] — [illegible] Liverpool.

Electrical Depot and Manufactory. — [illegible]

Microscopic Objects for mounting: 50 [illegible]

Microscopic Objects for mounting: 20 [illegible]

Microscopic Objects for mounting: 50 [illegible]

[illegible] **Engine**, £25; five-horse Compound [illegible]

Brass **Door Plate**, 9in. by 4in. with name engraved [illegible]

Name Plate for marking linen, any style, with [illegible]

Fretwork. — Illustrated Catalogue of every requisite [illegible]

Aerated Water Machinery, [illegible]

Oxygen Gas compressed into iron bottles [illegible]

Oxygen Gas compressed into iron bottles; [illegible] Compressed Gas Company.

Oxygen Gas compressed into iron bottles: [illegible]

[illegible] Artistic **Photographs**. Popular [illegible] post free. [illegible]

Cast Steel: practical process of welding, tempering [illegible]

Motor Castings, materials for Electric Bells [illegible]

Insulated Wire **Table**, showing size, weight, resistance [illegible]

Wimshurst Fittings. — Two 12-inch **Glass Plates**, [illegible]

Wimshurst **Influence Machine**, complete, with [illegible]

Wimshurst **Influence Machine**: [illegible]

Skates! Skates!! All sizes. Acme, warranted [illegible]

Square Elastic Thread, 1d., 2d., 3d., 4d., per [illegible]

Mesmerism, home entertainment with magnetism [illegible]

Electric Bell, 2½in., battery, 25 yards insulated [illegible]

Tools, best guide to purchasers; send four stamps [illegible]

Tool Chests, speciality, 25s., 37s., 45s.; [illegible]

Parallel **Bench Vice**, steel jaws, 2½, to open 3½ [illegible]

Planes. — Malleable iron [illegible] castings, ready [illegible]

Lunt's is the best and cheapest house for tools [illegible]

Engine, horizontal, 2in. by 4in., [illegible]

Pulleys of wrought-iron, turned true, and [illegible]

Friction Pulleys, [illegible] with fast and [illegible]

Shafting, Pedestals, and Hangers at low [illegible]

Cork Cutting Machine, "Acme" patent, [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 25, 1884.

ELECTRIC LAUNCHES.

UNDER the title of "Electric Launches" an interesting paper was read by Mr. A. Reckenzaun, before the Society of Arts last week, and, as might be expected, a businesslike discussion followed. It is obvious to those who give a moment's thought to the subject that if electricity can be economically used for propelling launches, it will speedily take the place of steam; for even if it costs more, the advantages are so great that any moderate increase in the expenditure will be cheerfully paid. In the first place, in a steam launch a very large portion of the boat is occupied with the engine and boiler, which, almost as a matter of necessity, involve smoke and dirt, and do anything but add to the comfort of the passengers; in the second place, in a steam launch the risk of accident is much greater than it would be if electricity were employed as the propelling agent. If a vertical boiler is used in a launch the tendency to upset is increased; if a horizontal boiler is employed a much larger portion of the total carrying space is taken up by the machinery. In an electric launch, on the other hand, the driving engine, the dynamo, occcupies a very small space comparatively, and the power generators, or immediate source of the energy, can be stowed away in the corners and arranged alongside the keel—thus not only leaving all the available space for the use of passengers, but also increasing the stability of the craft, by keeping the weights low down. Electric launches are, however, not a modern invention, and it therefore follows that there is some sufficient reason why they have not been brought into general use—a reason which will be found in the single item, expense. So long ago as 1838 Prof. Jacobi drove a boat by means of a primary battery and an electro-magnetic engine; and somewhere about 1850 an electric launch was tried on a lake at Penllegaer, near Swansea, under the direction of Mr. Hunt and Sir William Grove, who were the designers of the boat and machinery. Several other experimental trials are on record, but until Trouvé in 1881 started his boat *Eureka* on the Seine, the expense of working electric launches was practically prohibitive. The improvements in the dynamo effected by Gramme and Siemens have, however, brought the question again prominently to the fore, and the point to be decided now is whether the primary or the secondary battery is the cheaper source of energy, all things considered, as applied to the work of driving an electric engine. According to Mr. Reckenzaun, the cost of steam, secondary and primary batteries, is respectively 1, 2·5, and 12, which, on the score of expense, puts the ordinary zinc battery practically out of court. But other points besides those of mere cost of materials have to be considered, and it is probable that, after all, many persons would prefer the primary battery. So far as we know, for we are not familiar with the secrets of certain wonderful new batteries, there is no cheaper source of energy in the cell than the consumption of zinc, and as that costs in quantity about 3d. per pound, and two pounds yields an electrical horse-power per hour, it is easy to calculate the expense of that item in an electric launch. To take Mr. Reckenzaun's figures, the cost of zinc alone to drive a launch with five electrical (or four mechanical) horse-power, would be 2s. 6d. an hour; but to that must be added the cost of the acid or other exciting fluid, and also the value of the time expended in charging the battery. What with cleaning, amalgamating, mixing the solutions, and refilling a battery capable of doing six or seven hours' work at the rate of five electrical horse power per hour, one man would find plenty of occupation for a whole day, even with the best appliances; but the same amount of labour might be expended on a 6-horse steam-engine, and a dynamo for charging 50 accumulators, each of a capacity of 370 ampère hours, or one horse-power hour. That would give nominally five horse-power for ten hours; but it is never advisable to run a secondary battery right down, so Mr. Reckenzaun takes seven hours as the duration, and reckons the cost at 2s. 9d.; whereas the cost of zinc alone, in a primary battery supplying two electrical horse-power for seven hours would be 17s. 6d. It is not quite clear how the 2s. 9d. is calculated, but it is Mr. Reckenzaun's estimate, and obviously leaves out the interest, wear and tear, and other items, in connection with a steam-engine and boiler and a place in which to keep them—the cost of the dynamo and the two kinds of battery may be considered equal. Mr. Reckenzaun points out that it is hardly likely that any one will lay down a complete plant for the sole purpose of charging the cells of one boat, and, therefore, in order that electric launches may be useful, it will be desirable that charging stations should be established. A system of hiring accumulators will, as he says, best satisfy the conditions imposed in the case of pleasure launches; but it must not be forgotten that the duration of any trip is limited by the time during which the accumulators will give out energy, for it will not always be convenient to wait while the secondary battery is being re-charged, nor altogether feasible to replace the exhausted cells by others, which may be kept in stock ready charged. So far as pleasure launches are concerned, then, it is probable that the primary battery will at least meet with as much patronage as the accumulator, unless, indeed, someone devises a method of re-charging in as many minutes as the cells will last hours.

Mr. Reckenzaun's data in connection with secondary batteries may be useful. A Faure-Sellon-Volckmar cell weighs 56lb., stores energy equal to one horse-power for one hour, or 1,980,000 foot-pounds, or, say one horse-power per minute for each pound weight of the cell. The charging capacity is as much as 370 ampère hours, but it is not advisable to use more than 80 per cent., or 300 ampère hours. If the cell is discharged at the rate of 40 ampères, an almost constant current is obtained for 7½ hours, with an E.M.F. of 2 volts. If one horse-power is required for that time and at that rate of discharge, more than nine cells are wanted; but 47 cells will supply five electrical horse-power, and will weigh 2,632lb. About half the number of cells discharged at a rate of 80 ampères will supply the same quantity of energy, but only for less than half the time; or the 47 cells can, if desired, be made to give ten or twelve electrical horse-power for over two hours. To the weight of the battery 2,632lb. has to be added, that of the motor, which need not weigh 400lb., says Mr. Reckenzaun, if economically designed, and which will give four horse-power on the screw-shaft. Allowing a margin for leads, switches, &c., the total weight is about 28cwt., which Mr. Reckenzaun says is equivalent to that of an equally powerful steam-engine with the maximum stowage of coals. The launch sent to the Vienna Exhibition, which made many successful voyages on the Danube, is of steel, 40ft. long and 6ft. beam, with seats to accommodate 40 adults. The motor is capable of working up to seven horse-power with eighty accumulators, but with the exception of a slight rise just above the motor, the floor is quite clear, the accumulators and engines being beneath, out of sight. In such a launch driven by steam-power, the engine and boiler would occupy a length of 12ft., leaving only 15ft. available for seating passengers, whereas the seating capacity of the electric launch is 27ft. on each side of the boat; or, in other words, the steam launch would carry only twenty-two passengers to forty in the electric launch. The relative weights of machinery are about the same—viz., 50cwt., but in the case of the steam launch that includes 10cwt. of coals, which at 8lb. per i.h.p. per hour (7 h.p. actually given to the shaft) would allow of fifteen hours' continuous steaming, or just double the time that the launch could travel without injuriously drawing on the accumulators. The present accumulators yield 33,000 foot-pounds per pound of lead. Theoretically, lead separating from its oxide manifests energy equal to 360,000 foot-pounds, while the figures for iron are 1,900,000 foot-pounds. It is evident, then, that although nothing like those figures can be reached, there is a very large margin for the future advance of inventors with secondary batteries; but it is doubtful whether much more can be done with the motors, especially as Mr. Reckenzaun exhibited one of his inventions, just finished, which with a weight of 124lb. yields 1·37 mechanical horse-power, running at 1,550 revolutions, and giving 31 ampères and 61·5 volts. at the terminals. In connection with electric launches, the old debates as to the efficiency of the screw propeller are likely to be reopened, for in them the propeller is fixed on a prolongation of the motor shaft, and it consequently revolves at a very high speed. According to Mr. Reckenzaun, a fine-pitched propeller he exhibited gave an efficiency of 95 per cent. when running at 800 revolutions per minute. In the course of the discussion that followed the reading of the paper, it was pointed out that it was a fallacy to suppose that slip in itself was a loss, and the 5 per cent. lost by this propeller did not give any idea of the efficiency. To that Mr. Crohne (of Messrs. Yarrow) replied that such a pitch, about 10in. to a diameter of 20in., was unknown before, and he had been of the opinion that it would not do at all. He expected that negative slip and friction of the propeller would make a serious impediment; but when the experiments were made he found he was entirely mistaken. Mr. Reckenzaun said that the propeller was designed to run at 900 revolutions; and that if the speed were reduced to 300, not only would the pitch have to be altered, but the surface would have to be larger, which would entail more friction. The performance of this propeller is, in fact, a revelation, and it is to be hoped that before long some experiments will be made on a larger scale in steam vessels. The number of strokes made per minute by the pistons in fast-steaming vessels ranges from, say, the 133 of the *Stirling Castle* to about 1,000 in some of the torpedo boats; but as revolutions of the screw is the point to be studied, it will be seen that the electric launch is far ahead of anything known in connection with steam-engines. Admiral Selwyn commenced the discussion by suggesting that electrical propulsion would be specially applicable to lifeboats; but if that is to be so, some new form of battery will have to be devised, for, as a matter of fact, the electric launch is literally "at sea" when it gets into rough water, owing to the spilling of the acid solution. Admiral Selwyn also created some interest, not to say excitement, by stating that he had seen one-sixth of a pound of fuel producing one horse-power; and when challenged, he proceeded to give his idea of how it was accomplished. But as, so far as we know at present, such an economy is simply impossible, we may well [illegible] take care of itself. A [illegible] was the inquiry [illegible] Reckenzaun as to the cost [illegible] shown at Vienna. [illegible] by the answer [illegible] though it drew [illegible] the remark that if the [illegible] required to run con- [illegible] accumulators would be [illegible] the discharged set could be [illegible] another which he thinks could be [illegible] in a few minutes. [illegible] may be taken that a secondary [illegible] run down in seven hours, [illegible] seven hours in charging. [illegible] Mr. Preece, who had asked [illegible] the cost, stated that he [illegible] Vienna it was about £800, [illegible] was a little too much for [illegible] he has a strong faith in [illegible] batteries, and believes that before [illegible] will discover how to render [illegible] a launch even in [illegible] to the accounts, [illegible] battery p. 407) is [illegible] and will stand a good [illegible] and no doubt Mr. [illegible] devise a means of [illegible] but at present [illegible] been subjected to any- [illegible] than the shaking re- [illegible] alongside the tugs on [illegible] the electric launches [illegible] except in what is practi- [illegible] water. As to the question [illegible] is not damaged [illegible] formation of a film of [illegible] Mr. Reckenzaun stated [illegible] considerably reduce the [illegible] as it was broken [illegible] give off its maximum [illegible] constructed ac- [illegible] difficulty in getting [illegible] of the energy put [illegible] Reckenzaun; but he [illegible] be a long time before [illegible] What is wanted is the [illegible] exhausting coal itself [illegible] much of the [illegible] wasted in the furnace. [illegible] until some such dis- [illegible] will vessels be [illegible] by electricity [illegible] fifty years old, and [illegible]

[illegible] NOW MADE AND [illegible] USED. XII.*

[illegible]

[illegible] necessary to clamp to [illegible] standard, or bracket, [illegible] wheel to the two [illegible] At the concluding [illegible] to the advisability

[illegible] right through the top [illegible] at the same time [illegible] drilled in the same [illegible] indicated [illegible] in [illegible]

diameter, and the two lower ones should be at least ¾ of an inch from the bend of the flange, so as to allow the nuts to be easily turned and tightened up. These two bottom holes should be about 2in. apart, while the upper one should stand equidistant from the others, but at about ½ an inch from the top of the flange. The amateur will find at any of the good furnishing ironmongers, very neat skate screws with nuts to fit, of the form illustrated at Fig. 22. These screws have usually rounded heads, without the slot for the screwdriver to enter: but these can be easily cut with a metal-saw. Of course, any small bolts and nuts having a section of about ¼in. will do, but the ones mentioned are very neat in appearance. The holes being drilled and the bolts and nuts chosen, the bracket and limbs of the field magnet may be temporarily clamped together, in order to see what opening is left between the legs for the armature to turn in, at *a*, Fig. 23. In all probability some filing of the faces of the flanges and of the bracket will be necessary to insure a proper fit. A well-fitted armature should, if placed in the centre of the channels at *a*, leave a space of a trifle more than 1/32 of an inch to turn in: that is to say, there should be rather more than 1/16 of an inch clear space all round between the armature and the field magnets. Perhaps the quickest way to insure this distance being obtained is to roll tightly a single fold of stout brown paper round the armature and seal down the edge to prevent it slipping; then, having inserted the armature in the channels, to file away at the inner faces of the flanges, either towards the lower portions at *b b*, if the channels are too wide apart, or at the upper extremities at *c c*, if too close, until the whole fits accurately together. It is as well to remark that when the armature thus wrapped in paper is placed between the field magnets, to obtain a correct fit, *the solid portions of the armature should lie against the legs*, and *not* the portion of the armature which is hollowed out for the reception of the wire (see Fig. [illegible]).

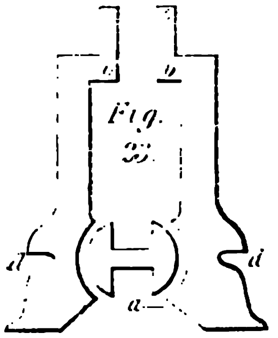
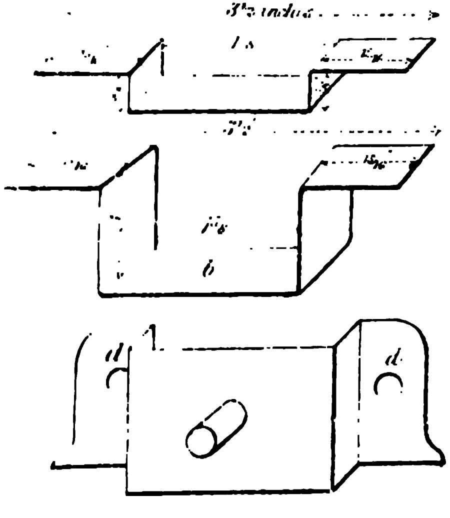


Fig. 23.

Fig. 24.



The magnets and brackets being thus properly clamped together, the hole in the top of the bracket (which ought to have been left in the casting, but if not may be bored now) should be cleaned out to ¼in. diameter. When this is done, two pieces of hard rolled brass sheet ⅛in. thick, 6in. long by 1in. wide, must be [illegible] squared up. One of these, which we shall for the future call the "back bearing," and which is to be made to fit that end of the dynamo at which the driving wheel is to be placed, and which we shall henceforward call the "back" of the dynamo, is to be bent four times at right angles, as shown at Fig. 24 *a*, where the dimensions are given. In order not to crack the brass when bending to shape, it will be well, after having given the general form by bending gently and gradually over the jaws of a vice, to heat the bends over the flame of a spirit lamp until nearly red hot, and then to hammer up more exactly to shape, repeating the heating after each hammering until the desired sharpness of outline has been obtained.

When this object has been attained, another almost similar bearing is formed out of the remaining piece of sheet brass, the principal difference being that, as this is to be the front bearing, between which the commutator will have to turn, a much greater depth must be given to the central bent portion, as may be seen at Fig. 24, *b*, the dimensions being given in inches as before. When the brass has been bent to these forms, the bearings thus produced should be laid each against its own respective end of the dynamo, in such a position that the centre of the bend comes in the centre of the channel, the two flat extensions lying close to, and flat against, the slotted lugs shown at Fig. 23, *d d*. The bearings should now be cut in a sloping fashion to follow the outline of the lugs, as shown at Fig. 24, *c*; but the outline of the slotted portion should not be followed, as a ¼in. hole must be drilled in the brass at this point to take a ¼in. bolt and nut. The exact position of these holes may be obtained by holding each bearing in succession against its own proper extremity, and scratching with a steel point on to the brass the position in which the slots in the lugs fall; then with an Archimedean drill, a ¼in. hole can be drilled at each extremity *nearest* to the centre of the bearing, as shown at Fig. 24, *d*.

Having got so far, let us clamp the back bearing in its place by means of two bolts about 1in. long, passing through the holes in the bearing and through the slots in the lugs, held in their places by two nuts screwed down on to the front lugs of the dynamo. Taking the armature in one hand, we roll, as before, one fold of paper round it, and put a dot of Brunswick black on the extremity of the trunnion rod at the back end of the armature (the end where the holes are bored for the wire to come out is the front, the other is the back), and then insert it into the channel between the legs of the field-magnets, until the trunnion rod or shaft touches the brass forming the back bearing. In so doing it will leave a mark of Brunswick black, which will be the point at which a ¼in. hole must be bored. This must be done most carefully, so as to preserve centricity; and when done must be rimed out and bushed with a piece of brass tubing of about 5/16 external diameter, the internal diameter of which must exactly correspond with the external diameter of the driving-shaft or trunnion of the armature: in fact, this latter must fit exactly into the tube, without any shake. This piece of tubing should be about 1¼in. in length, and should be soldered into the central hole in the back bearing, and should extend inwards to such a degree that when the back bearing is clamped in its place, with the armature in its position, with the back trunnion in the tube, and the back head flush with the back of the magnets, it should just rest against the back head of the armature.

In a precisely similar manner the centre of the front bearing is found: that is to say, the back bearing being removed, the front bearing is clamped to the front of the dynamo, the armature, rolled in one fold of paper, is inserted from the back end of the dynamo, front end forwards, and care taken to moisten the front end of the driving-shaft with Brunswick black or other colour, so as to get a mark where it touches. The hole being drilled and rimed out, as in the previous case, is to be likewise bushed with the same kind of brass tubing, but, in the front bearing, the tube should be only flush with the inside of the bearing, and should not extend in towards the armature.*

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* To those who prefer fitting together the finished castings, to making every part themselves, I feel much pleasure in recommending the castings advertised in our columns by Mr. H. Jones, who has submitted some to my examination, which I find fully in accordance with my instructions.

PRACTICAL NOTES ON PLUMBING.—XCII.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from p.* 402.)

Hot-Water and Gas Work and Fitting.

WE have now come to that part of our work which is often discarded by the plumber as being beneath his notice, and by those who cannot do this class of work, as being something out of the trade; but the fact is, that our best hot-water work is generally, as it should be, left to the *qualified* plumber.

We will presume that you are thoroughly acquainted with the laws which govern fluids; but there is one law which we shall have occasion to draw your particular attention to, that is, the law of heat when held in these fluids, for without a knowledge of such law, it would be useless to attempt hot-water work unless it be by rule of thumb work only.

Every one is familiar with the fact that when their hand, if of a different temperature, is applied to a hot or cold body, that the *hand* is readily made sensible to the fact, and according to the difference in the temperature so will the amount of sensation be felt. This is one way of experiencing the effects of heat. We all know that the heat of the sun's rays is felt by us all more powerfully at one time than another; but we do not all know that the heat from the rays of the sun on a hot summer's day will, on one acre of ground, produce as much steam as could be produced from a boiler consuming at least six tons of coal; and the uninformed do not know that the radiant rays of the sun traverse through space at a velocity of 190,000 miles per second, nor does he know that heat and cold are one and the same, which according to its degree of temperature acts upon the nerves, and which sensation is experienced in strict accordance with the temperature of the applied body.

We speak of heat when this substance (if it be a substance) is in temperature above that of the common air, or the applied body, and of cold when it is below this temperature. There are some bodies which may be considered as capable of absorbing heat, which absorbed heat will reside in such bodies for a very considerable time, and often in a latent state. For instance, the heat in ice is latent, and not perceptible to our senses of feeling. For argument, suppose you place your hand into water, the temperature of which is exactly the same as that of your hand, the heat phenomena cannot be felt, therefore the heat is latent to you. For the same reason ice holds latent heat. Water solidifies at 32°, and will take in or absorb 140 degrees of heat to each pound of ice before it will rise in temperature, or, if I may so speak, feel hotter; and a further 1,000° more heat must be hidden in water before the ice is converted into steam, so that we say that in steam there is 1,140° heat latent, and although we put a thermometer into this steam, it will only register 212°. This is a curious fact, and only goes to prove that which I have before written on this subject, and it is good for us that this is so, for if all the water were suddenly to turn into steam, an explosion would take place every time we boiled a drop of water. I may add that you may keep boiling away at water, and so drive out all the air held in solution, and when such is done you may raise the temperature to at least 360° Fahr.; you are then liable (if the air be absent) at any moment to have an explosion. For my part, I am quite convinced that many of our terrible boiler explosions which have never been accounted for, have been caused by the continual boiling of the same water, which is often the case for days and nights together, and which must drive off the air held in solution before spoken of.

To prove this, take a piece of Wenham ice, and place it in a large test tube, then cover it with turps (turpentine). Carefully melt it, and without admitting the air, make it boil. The heat required will be considerably more than 212°, but as soon as steam is generated the whole of the water will jump out of the tube as though gunpowder were under it.

I have said that the temperature of issuing steam is never more than 212°, but it must not be lost sight of that water may be heated to a very high temperature, according to the strength of the vessel wherein it is held. And when this is done take particular notice that you leave sufficient room in the vessel for the expansion of the water, which will expand when heated from 39·40° (the greatest point of condensation) to 212°, one twenty-third part of its bulk, and if inclosed within a close vessel will exert a power of 14,121lb. on the square inch. It also should be known that water in our common atmosphere boils at 212°, but double the pressure of the atmosphere on the surface of the water, and though this may at first sight appear paradoxical, it will not boil before it has attained 250·52° F., and if your vessel be constructed so as to resist, say, 25 atmospheres of pressure, then your water will not boil until it has attained the heat of 439·34° F.

I may here state that one cubic inch of water will make 1,696 cubic inches of steam, compressed to 15lb. to the square inch. The following may assist you in your reasoning respecting the quantity of this latent heat. You may say that snow is the very essence of cold, but in comparison to the following will feel quite warm. Take two bowls of snow, and put into one bowl half as much common salt. Place your hand into this mixture, and you will be very pleased to withdraw the hand, if only to place it in the bowl of pure snow, which will then seem to be warm, and, of course, the heat not latent. I may add that when mercury is frozen, the mere fact of picking it up with the naked fingers will blister the fingers just as if it were a piece of hot iron. These are simple experiments whereby you will be better able to judge what constitutes the different degrees of heat, latent, radiant, or otherwise.

(*To be continued.*)

ELECTRIC LIGHTING AT THE TRINITY LIGHTHOUSE, SOUTH FORELAND, NEAR DOVER.

SIR JAMES DOUGLASS and several other scientific gentlemen are about to institute a series of electrical experiments on behalf of the Trinity Board, with their existing electric lighting machinery and an enormous De Méritens machine, at the two lighthouses near Dover. Dynamo machines do not appear to rank as the best generators for lighthouses; as Holmes's magnetic induction machines have held their own at this important lighthouse, and, amongst the trials about to take place, a De Méritens large-size magneto generator will be installed, which is expected to yield magnificent results. These machines of De Méritens will soon occupy all the lighthouses on the French coast, and it is a wonder these generators have been so little adopted in this country.

Count du Moncel, in his translated little work, speaks of their high power, as compared with the small force required to drive them. In this machine alternate currents are produced, and the whole of the armature current is utilised during its entire or part revolution. This form of armature also requires but little h.p., on account of the peculiar arrangement of the circular magnetic field it rotates in, on a smaller scale, as in the factory machines, which yield about 1,200 candle-power, at about 750 per minute, and absorb only 1¼ h.p. The small machines contain about 3cwt. of steel inducing magnets, with their poles placed alternately N. and S., which operate upon 16 annular magnets forming a ring tire armature, which are arranged on the periphery of a brass wheel. Each annular magnet contains about 1½lb. of wire, and the iron core is built up of pieces of iron, instead of being solid castings, which heightens the induction effects, and also prevents the formation of injurious Foucault currents. Two brilliant electric lights have hitherto been visible for many miles at sea from the South Foreland Lighthouse; but the experimental installation soon to take place will eclipse the light at present emitted from the two lanterns on the tower. It was from these lighthouses Prof. Tyndall carried out his famous experiments on sound by a fog siren driven by the engines of the lighting machinery.

HOW TO MAKE A CHEAP LATHE.—VII.

The Slide Rest.

THIS is a piece of mechanism which most amateurs who essay metal turning at all desire to possess; but which, nevertheless, few except professed machinists have the courage to attempt, or attempting, have the perseverance to complete. And yet to those who have undertaken successfully the construction of a common lathe, there should be nothing to hinder them from the construction of a slide rest also. Let us, in the course of a half-hour's chat, endeavour to make the matter as simple as possible.

Fig. 85 gives a perspective view of the rest, in which A is the saddle, B the transverse slide, C the longitudinal guide, D the tool-holder, E the screw handle for transverse movement, F the handle for longitudinal motion.

For these, plain patterns will be wanted. That for the saddle, Fig. 86, will differ from the casting in these respects only. The holes for the traversing screw will not be cast in. A slight allowance for fitting must be made on all working surfaces—a full 1-32in. if we are going to fill up our castings, a bare $\frac{1}{8}$in. if it is intended to plane them. The two dovetailed shaped strips *a a* will be left loosely wired on, to be drawn into the mould after the main body of the pattern is lifted out, and the interior nut recess will be cored out. Fig. 87 represents the wood pattern in section, Fig. 88 its core box. The pattern of the transverse slide, Fig. 89, will also have its dovetailed strip left loose. The remarks made relative to the saddle will also apply to the longitudinal guide, Fig. 90. In fact the saddle pattern may be altered for the guide by removing the base which slides on the lathe bed and substituting for it the circular foot *a*. Two sweeped prints and a core box to match Fig. 91 are wanted for the slots, by which a limited spherical movement is given to the tool. A pattern for the movable slides, Fig. 92 *a*, and also one for traversing nuts, Fig. 93, will complete this part of the business.

We begin our fitting at the saddle, and travel upwards. And we assume as before that a planing machine is not available. File the under side of the saddle accurately, using winding strips and surface plate, and following the instructions and hints given relative to the filing of the headstock castings in Art. III. Operate on the upper face in a similar manner, and check with calipers to insure perfect parallelism. Make a metal templet, Fig. 94, to the angle of the slides, about 60°, and file one edge straight to this templet, and at right angles with the timbers of the bed, checked with a square not less than 10in. or 12in. in length, held against the saddle when the latter is in position. Scribe the opposite edge parallel, and file that until a second templet, Fig. 95, can be slid from end to end and bear with equal pressure on every section. File the ends square, and for appearance sake brighten up the remaining parts of the saddle.

Drill the holes, two for the traversing screw, one for the hold-down bolt. If you still presume on the kindness of your friend who allows you to use his lathe, you will bolt the saddle to the angle plate, and hold your drill in the slide rest, as when boring the hole for the back centre of the headstock, Art. 3. But you can do the same as I did—fit the parts of the rest in your own lathe, using the drill chuck and plate for these holes. Taking the drill plate, I screwed thereon a squared cubical block of wood in such a position that with the face of the saddle laid against it, the centres of the holes for the screw coincided with the centre of the lathe. It stood out sufficiently far—about $4\frac{1}{2}$in.—to insure steadiness longitudinally; in fact it was an improvised angle plate for temporary use. The hole in the front of the saddle will be drilled to $\frac{5}{8}$in. diameter, that in the back to $\frac{1}{2}$in. The one for the hold-down bolt will be the same as for the headstocks, $\frac{5}{8}$in. tapping.

We go on with the filing business, leaving the long screws and nuts until the last. Take the next casting in ascending order—the transverse slide, Fig. 89. File the face and one edge, the one marked *a*, true, also the sliding face parallel with the first. Make a metal templet, Fig. 96, just the reverse of that shown in Fig. 94, and use it as a gauge for filing the bevelled edge *b*, taking a large three-corned file for the purpose. Take pains with all these sliding faces, and finish in every case with the scrape.

File the adjustable slide C to thickness, drill and countersink two 5-16in. holes as shown, set in position, allowing a little for filing off the bevelled edge, and drill and screw two corresponding holes in the transverse slide, using ordinary stove screws to secure the adjustable piece in position. Mark the ends of the loose piece with metal templet, remove, and file to a

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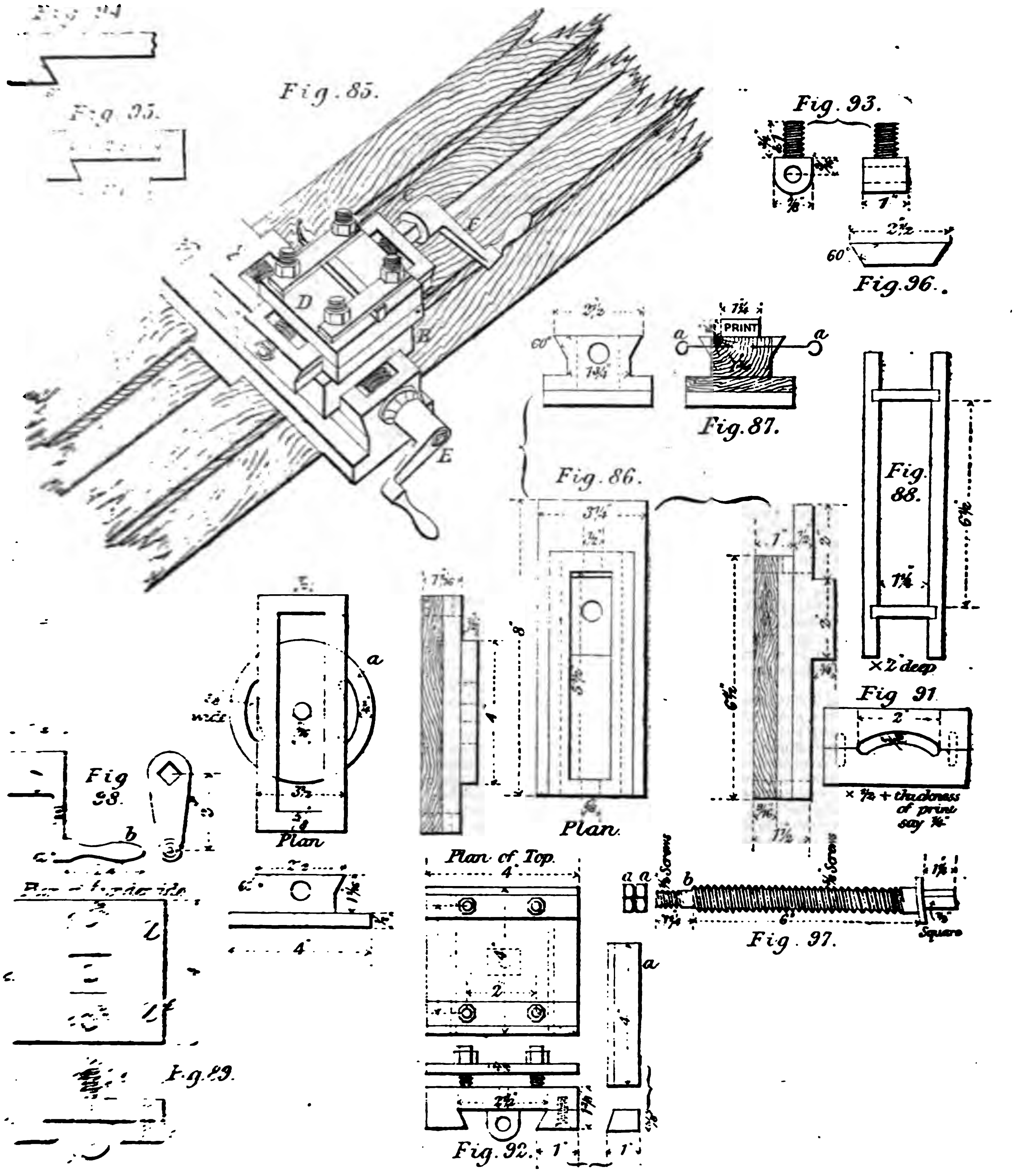

[illegible] with the saddle [illegible] the loose [illegible] the accuracy of [illegible] the edges, d, e, f parallel [illegible] with the [illegible] through the exact centre of the [illegible] for the reception [illegible] of which more anon. Two [illegible] for the reception [illegible] the transverse [illegible] the upper guide for longitudinal [illegible] capable of limited [illegible] the edges with [illegible] fashion as the [illegible] in the ends [illegible] face upon the [illegible] and the edge of [illegible] exactly through [illegible] slots with files, [illegible] from the edge of the

[illegible] slide and tool box, Fig. 92. Precisely the same routine is to be observed as in the transverse slide. Instead, however, of the two screws for spherical movement, we have four for the purpose of tightening the tool. Over these studs two plates of wrought iron, *a a*, are slipped and held down on the tool by the nuts. If you choose, you may make four springs to keep the plates just under their nuts, and so avoid the slight trouble of lifting them up when it is desired to slip a tool underneath. Get a bit of 1-16in. hard brass wire, wind it round a ½in. bar about half a dozen times, cut off, and slip over tightening screw. When each screw is thus provided with its spring, drop the plates and nuts finally in position.

Two traversing screws precisely alike, Fig. 97, will be required. They are made of ⅝in. rod, collars being welded on. Skim over in the lathe, turn the collars, and screw—preferably in the lathe—or, failing that, with stock and dies. The ½in. screw at the end is for the lock nuts, *a a*, and the turned portions, *b b*, run in the holes drilled in the castings, Figs. 86, and 90. The square part is for the handle.

For the handles get a couple of forgings or brass castings, made to Fig. 98. File the square holes to fit over the square ends of the traversing screws. Drill a 5-16in. hole at *a*, into which rivet handle *b*, turned out of a bit of ⅜ rod, or of brass.

Turn the shoulder of the nut square, and cut a ½in. thread, Fig. 93, *a*. In one nut, the one fitting into the tool slide, the screw will be ¾in. long, thus terminating on the upper face of the slide. But in the other case the screw will be an inch long, and the ¼in. which projects above the face of the transverse slide will be turned to 7-16in. to fit the hole in the longitudinal guide, Fig. 90, and the guide will swivel round upon this.

Drill a hole and tap a ⅝in. thread to fit the thread of the traversing screw, keeping the centre of the hole at exactly the same distance from the shoulder of the nut as the holes in the saddle and the longitudinal guide, Figs. 86, 90 are from their faces.

Provide the saddle with a hold-down bolt like those made for the headstocks, Art. V. Put all parts together. Remove the adjustable slides, screw in the brass nuts, slip the slides into position, with the nuts within their spaces, run in the traversing screws, and finally screw on the adjustable pieces. If the slides wear in the course of time, a few strokes of the file over the top face of the loose pieces will insure a close fit again.

About the cost. The castings weigh 18lb. at 2d. per lb. = 3s. Brass nuts and handles, 1¼lb. at 1s. = 1s. 3d. Screws and nuts, say, 2s. Total, 6s. 3d. Seven shillings will cover cost for material. So that our account stands thus :—

			s.	d.
Art.	I.	Castings	15	0
,,	II.	Timber	10	0
,,	V.	Sundries	15	0
,,	VI.	Chucks	13	0
,,	VII.	Rest	7	0
			60s.	0d.

For three pounds, then, we get a lathe and accessories that could not be purchased for ten. It is the growth of many hours of labour—to me of labour *con amore*. Its description, now concluded, has been a pleasurable task, and I trust many of my fellow mechanics will thereby be induced to construct one for themselves. Turning, sawing, drilling—it will execute these operations with ease. The little saw would be simply invaluable to many home-workers, as also the drill chuck. Many an hour have I laboured, before I had a lathe, in drilling small holes with a common brace. By means of the drill chuck and plate I can now drill much larger holes without one-tenth of the labour formerly necessary. Available also for almost every description of ordinary light turning, it becomes in the wide range of its operations a *useful* as well as a *cheap* lathe.

THE CHISEL AND CHISEL-SHAPED TOOLS.

THE first day I entered the machine-shop I was given a hammer and a cold chisel wherewith to chip the ends of some bolts level. I had looked forward to my entry into the shop with a great deal of pleasure, for my heart and mind were set upon becoming a skilful workman. The idea of being able to cut and shape metal to my will, and form it into the machines that were to save mankind the exercise of mere brute force, had such a charm for me that it was the height of my ambition. An apprentice of some two years' standing was to show me how to use this chisel, which he did as follows: "You hold the chisel so, and the hammer so, and then you chip this way," and he cut off the end of the first bolt very nicely and quickly. I tried to follow him, but after the first blow, which by chance struck the chisel-head sideways, I became aware that my hand was dangerously near to the chisel-head. I realised this more thoroughly at the second blow, for the hammer fell upon my thumb, to the great amusement of my neighbours. After that I could not be persuaded to hold the chisel near the head unless I held the hammer pretty close to its head, so that I could take better aim. For two days I struggled on, left to myself to find out by bungling along how to grind the chisel, and all the other points that could have been taught me in an hour. What was worse, I became disheartened, for instead of finding all plain sailing, with nothing to do but to master the principles of tool using, feeling every day that I had made some progress, I found myself floundering in the dark, not understanding anything of what I was doing, asking others to grind the chisels because I had no idea how to do it properly myself, and at the end of the first month I should, but for the authority of my parents, have tried some other business. The machinist's trade seemed to be nothing but one-half main strength, one-quarter stupidity, and the other quarter hand skill that every man had to work out for himself, for no body seemed able to help me. Many a boy meets just this same experience, and getting discouraged drifts about a month at this trade, two months at that, until he finds himself at last without any trade at all, and very often in his old age without the means of earning an honest livelihood. Examples of this kind are, I believe, within the personal knowledge of most of us, and the fault is often attributed to the absence of an apprenticeship system, but if we go deeper I am persuaded that it will appear that it is more in the want of intelligent preparation for the workshop.

Parental authority, as I have said, saved me from this misfortune, but since then I have, in the course of years, mastered the principle involved in the use of this cold chisel, and I can now draw you two pictures, which I hope will not be uninteresting. Suppose when I went to the shop doors to ask f employment the superintendent said to me, "We to be a machinist, do you? Well, why do think you are fitted for it; do you know any

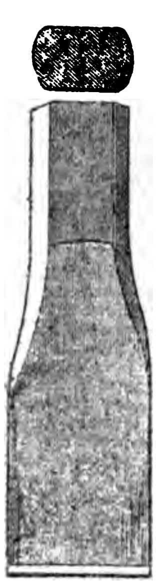

Fig. 1.

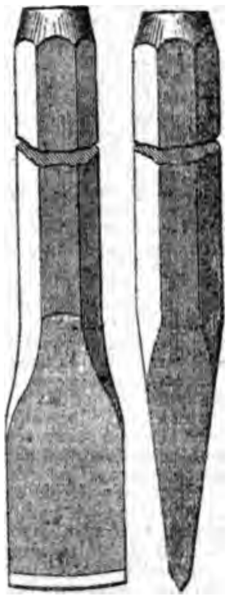

Fig. 2.

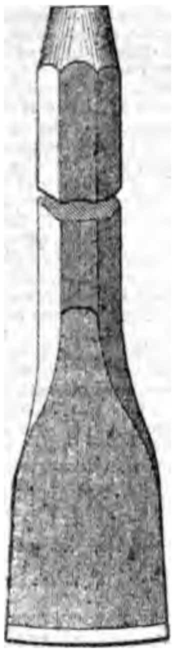

Fig. 3.

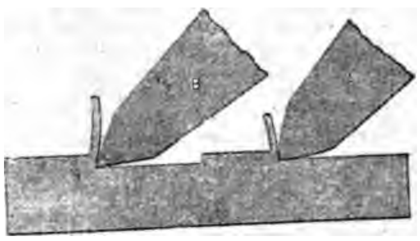

Fig. 4.

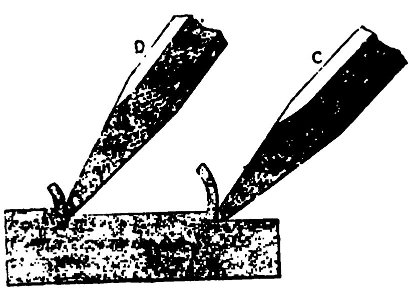

Fig. 5.

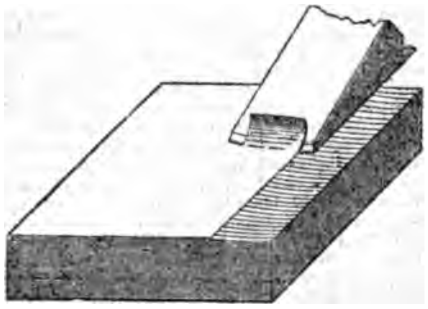

Fig. 6.

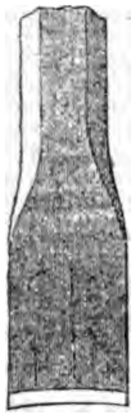

Fig. 7.

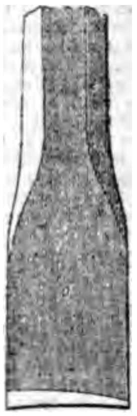

Fig. 9.

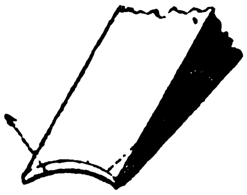

Fig. 8.

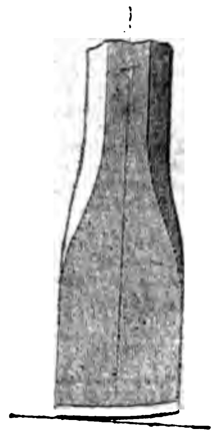

Fig. 10.

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* A lecture delivered by JOSHUA ROSE, M.E., before the Franklin Institute, Philadelphia.

about it, or about tools? On what foundation have you built the opinion that you will ever make a good machinist?" What could I then have answered, except that I thought so, hoped so, and meant to try my best. But suppose I was again a boy, and again found myself at the shop door, having previously taken enough interest in mechanics to have remembered the principles I had already been taught, I could take a pencil and a piece of paper and answer him thus:—

I can only say, sir, that I have prepared myself somewhat for a trade; here, for example, in figures 1 and 2 are shown the shapes in which flat chisels are made. The difference between the two is that, as the cutting edge should be parallel with the flats on the chisel, and as Fig. 1 has the widest flat, it is easier to tell with it when the cutting edge and the flat are parallel, therefore the broad flat is the best guide in holding the chisel level with the surface to be chipped. Either of these chisels is of a proper width for wrought iron or steel, because chisels used on these metals take all the power to drive that can be given with a hammer of the usual proportions for heavy clipping, which is—weight of hammer, 1¾lb; length of hammer handle, 13in.; the handle to be held at its end and swinging back about vertically over the shoulder.

If I use so narrow a chisel on cast iron or brass, and give full-force hammer blows, it will break out the metal instead of cutting it, and the break may come below the depth I want to chip and leave ugly cavities. So for these metals the chisel must be made broader, as in Fig. 3, so that the force of the blow will be spread over a greater length of chisel edge, and the edge will not move forward so much at each blow, therefore it will not break the metal out.

Another advantage is that the broader the chisel the easier it is to hold its edge fair with the work surface and make smooth chipping. The chisel-point I must make as thin as possible, the thickness shown in my sketches being suitable for new chisels. In grinding the two facets to form the chisel, I must be careful to avoid grinding them rounded as shown at A in the magnified chisel ends in Fig. 4, the proper way to grind them flat as at B in the sketch. I must make the angle of these two facets as acute as I can, because the chisel will then cut easier.

The angle at C, in Fig. 5, is about right for brass, and that at D is about right for steel. The difference is that with hard metal the more acute angle dulls too quickly.

Considering the length of the cutting, it may for heavy chipping be made straight as in Fig. 1, or curved as in Fig. 3, which is the best, because the corners are relieved of duty and are therefore less liable to break. The advantage of the curve is greatest in fine chipping, because, as you see in Fig. 6, a thin chip can be taken without cutting with the corners, and these corners are exposed to the eye in keeping the chisel-edge level with the work surface.

In any case I must not grind it hollow in its length, as in Fig. 7, or as shown exaggerated in Fig. 8, because in that case the corners will dig in and cause the chisel to be beyond my control, and, besides that, there will be a force that, acting on the wedge principle and in the direction of the arrows, will operate to spread the corners and break them off.

I must not grind the facets wider on one side than on the other of the chisel, as in Fig. 9, because in that case the flat of the chisel will form no guide to let me know when the cutting edge is level with the work surface.

Nor must I grind it out of square with the chisel body, as in Fig. 10, because in that case the chisel will be apt to jump sideways at each hammer blow.

(*To be continued.*)

APERTURES OF THE PRINCIPAL TELESCOPES.

IN an article on the progress of telescopes as regards size, the *Revue Scientifique* makes the following remarks, and gives a list of large refracting telescopes, which we have corrected, down to apertures of 15in.

At the end of the 18th century Herschel gave a very great impulse to physical astronomy. His amazing manual dexterity, his activity, his patience, led to the great works which made of him one of the greatest minds that England ever possessed. Guinand and Fraunhofer led to the realisation of large objectives by the progress they instituted in the manufacture of optical glass, while a mechanism of clockwork compelled the glasses and telescopes to follow the diurnal movement of the stars. All modern instruments are mounted in this manner. The tendency is toward enlargement, so that telescopes have reached such a size that some possess mirrors of 1·20 metres in diameter (Paris and Melbourne), with refractors 0·66 metres aperture (Washington), of 0·75 metre, and even one metre in diameter. Is this mania *for enlargement justified?* Arago, when he asked from the Chamber the credit necessary for the construction of an objective of 0·38 metre, believed that, by raising the enlargement of the glasses to 6,000 times, objects upon the moon 20 metres in length or 2 metres in width should be seen, the causeway of a railroad, fortifications, and monuments. The single difficulty in the way of realising this hope lies in the deficient luminosity of the images. It is yet impossible to determine to what extent the increase of the optical power of a lens or of a telescope is more than compensated by the increase of spherical aberration, the difficulty of manipulation, the instability, and deficiency of light. To give a more exact conception of the fineness of details that are attained in a good instrument, we may recall that Schiaparelli, in his observations upon Mars, made at Milan with a lens of Merz, of 0·218 metre aperture—Mars being distant 14 million leagues during the opposition of 1877—could distinguish a round spot 137 kilometres wide. From Mars an island such as Sicily, a lake of the size of Lake Ladoga or Tshad, could have been seen, a zone of 70 kilometres would have been visible, and Jutland, Cuba, or Panama would have been seen. The lens at Washington, of 0·65 metre, would show details but one-third the size, that is 44 to 24 kilometres; upon the moon the lowest dimensions would be 315 metres in size, upon the sun 177 kilometres, upon Venus 36 kilometres, upon Jupiter 555 kilometres. Experience proves that the most useful aperture is from 0·38 metre to 0·40 metre.

The following is a table of instruments of which the greatest diameter is 0·92 metre. The number of lenses whose diameter is greater than 0·245 metre does not exceed 32.

Observatory.	Aperture in centimetres.	Maker.
Lick, in Cal.	91·5	Clark and Son.
Pulkowa	76·0	Clark and Son.
Nice	76·0	Henry Bros.
Paris	73·5	Martin.
Vienna	68·5	Grubb, 1881.
Washington	66·0	Clark, 1873.
McCormick, Chicago	66·0	Clark, 1879.
Newall, Gateshead	63·5	Cook and Son, 1868.
Princeton, N.J.	58·5	Clark, 1881.
Strassburg	48·5	Merz and Mähler, 1879.
Milan	48·5	Merz, 1881.
Dearborn, Chicago	47·0	Clark, 1863.
Van der Zee, Buffalo, N.Y.	46·5	Fitz.
Rochester	40·5	Clark, 1880.
Madison	39·5	Clark, 1879.
Dun Echt	39·5	Grubb, 1875.
Royal Society (Dr. Huggins)	39·5	Grubb.
Pulkowa (smaller)	39·5	Merz and Mähler.
Harvard Coll., Mass.	39 5	Merz and Mähler.

The observatory at Lisbon has a telescope with an aperture of 14·8in., and there is in course of construction (the above are not all quite finished) a telescope of 28in. or 29in. (71-74 centimetres) for Yale College, by Clark and Son.

HOW TIME-TABLES ARE MADE.

ONE of the most laborious things connected with the management of a railroad is the instituting of changes in the time-table governing the running of trains. Instead of its being done with pen and paper, as many suppose, the entire running arrangement of all passenger and freight trains, their crossing of other tracks or passage of other trains, their stops, and lost time are calculated by simple common pins and spools of different coloured threads. Before a time-table or schedule is prepared the time chart is first perfected. To prepare a time-chart a large sheet of drawing-paper is first stretched on a smooth surface and mounted on an easel. The chart is ruled either for two, five, or ten minute time by horizontal and perpendicular cross-lines. The time is marked above the horizontal line, and the distances, or stations and terminals, down the first perpendicular line. For illustration, 12 midnight is the mark on the first horizontal line, and each hour is marked until the 24th, or the following midnight hour, is reached on the last horizontal line. Between the hour-lines the space is divided into minutes and graduated as fine as desired. On a two-minute chart the space between the hours is divided into ten minutes time, and the ten minutes time into two minutes time. The hour-lines are made heavy, and the lesser lines are of a higher shade to distinguish them. The one terminus of the road—Milwaukee, for instance—is marked on the first line beside the first time-mark, 12 midnight. The other stations follow down the perpendicular line until the other terminal is reached. Then all is ready to prepare for the running arrangement, provided the pins and thread are ready. A blue thread means a passenger train, a red thread a freight train, and if the trains of other roads use part of the track they are designated by a different coloured thread. It is calculated that the running time shall be, say, twenty-five miles an hour, and, for the purpose of illustrating, the tracing of one passenger train will answer the purpose of explaining them all. A passenger train leaves Milwaukee at 8 a.m. A pin is placed on the horizontal line at the 8 a.m. time-mark and the end of the blue thread fastened thereto. If the train runs without stopping for 50 miles, the blue thread is stretched over opposite to the station at which the stop is made, and directly under the 10 a.m. time-mark another pin is stuck, and the blue thread wrapped about it to keep it taut. If this is a stop, say of 40 minutes, the blue thread is stretched to the 10.40 a.m. mark on the direct line with the same station, and another pin stuck and the blue thread wrapped. The train starts and its entire course is thus timed and distributed along the road. If the railroad has, say, 40 or 60 passenger and freight trains running daily, the time-chart, when it is completed, looks like a great spider's web stretched out with pins. But little work then remains to transfer the time and stations to the time-table, and the schedule is ready for the printer.—*Milwaukee Sentinel.*

KNEE-BREECHES TROUSERS.

FASHION, notwithstanding its caprices, is subject to the controlling influences of the sense of comfort and that of appearance. We may say that of these the former influence, on the whole, predominates in the dress customs of the male, and the latter in those of the female sex. On this hypothesis one can understand how a desire for warmth, developing with the growth of civilisation, has led our countrymen, or most of them, as well as our Continental neighbours, to abandon various cooler and lighter, and even more wholesome, modes of covering the nether extremities for that of our own day, which is probably as inelegant, and sometimes as inconvenient, as it is protective. We have left behind us the British kilt, the Saxon leg-swathing, thee thigh-breeches, the knee-breeches, and have put on trousers. Ours is the century of long clothes. It may be questioned whether we have gained much by the change. Some, indeed, of our ancestral garments may, by this time, be too long out of date to be recoverable. The kilt and leg-bandage, for example, are separated from us, not only by centuries of disuse, but by differences of sentiment and occupation between our time and theirs, which must render their revival in any general sense well nigh impossible. The Elizabethan costume is in the same position; but the short clothes of the Georgian era still hold an established place among varieties of dress, though not that of the governing type. They seem to form the chosen habit of those whose lives abound in muscular movement. Thus they set the fashion of boyhood in the knickerbocker suit; they commend themselves to athletes, and especially to those of them who run much; farm labourers often wear them; the infantry soldiers of more than one Great Power find them serviceable. Might they not be even more commonly worn in civil life than they are? We think so, and though we cannot here follow all the intricacies of an argument as to whether or not knee-breeches are on the whole more seemly and convenient than trousers, whether the use of the latter should not be conceded to the man of unshapely limbs, and so, forth; still, it seems to us that in certain conditions at all events the elder costume might be adopted with advantage. Speaking broadly, we may say that all callings which entail much physical exertion would profit by the change. In particular, this is true of labour in the open air. In this form of work especially, where there is frequent and prolonged movement of joint and muscle, the weight of surplus clothing soon occasions weariness, and the surroundings are not the most cleanly. The labourer if knee-breeched and gaitered would be disencumbered of as much heavy moleskin or corduroy as would otherwise fall below the knee, a part of his clothing would not then as now flap about the feet for no good purpose but to be soiled by the mire of his work, or in wet and cold weather to lead to illness by chilling or freezing on his legs. Gaiters of some close and not too heavy material might be worn over the stockings. They would be comparatively out of the way of dirt, would maintain warmth, would brace the muscles by equal and moderate pressure (a noteworthy consideration with men who are much on their feet), and if wetted might be easily removed and replaced by another pair. If some such reversion to a prior type were brought about in the dress of workmen, the change, being one of arrangement even more than of quality of clothing, would enhance the comfort, facility, and effect of their exertions without prejudice to their health. It is at least suggestive that many workmen do endeavour by various devices, such as leggings, straw ropes, and the like, to make as little of their trousers below the knee as possible.—*Lancet.*

CAPTAIN EADS estimates that the ship railway across the isthmus of Tehuantepec can be completed in two years for the sum of 25,000,000 dols.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE Annual General Meeting of this Society was held on Wednesday evening, the 16th inst., at 25, Great George-street; Mr. J. K. Laughton, F.R.A.S., President, in the chair.

The Secretary read the Report of the Council, which showed that the past few months mark a very important epoch in the history of the Society. In October the Council received the intimation that Her Majesty had been graciously pleased to grant the Society permission to assume the prefix "Royal." In consequence, the Society has become, and will henceforth be called, the "Royal Meteorological Society." In December, the Fellows made certain alterations in the by-laws by which the annual subscription has been increased. The Report also showed that the Society is doing a great deal of practical work, not only by holding meetings and publishing the papers read at the same, but also by the establishment of a large number of observing stations which are regularly inspected, so that the results obtained from them may be strictly uniform and comparable. The number of Fellows is 549, and of honorary members 19, thus making a total of 568.

The President then delivered his address, in which he referred to the experiments made by Mr. Saxon Snell, Mr. Bertram, and Mr. Hele Shaw, with the object of determining the coefficients of Biram's anemometers; as yet these can scarcely be considered quite satisfactory; for though made with the utmost care, they give results differing from each other by nearly 25 per cent., and from the known truth in opposite directions. The reduction of barometric readings to sea-level is another problem of great interest and importance, the solution of which is far from perfect, and as applied to the converse determination of altitudes has been pronounced by Mr. Gilbert, of the U.S. Geological Survey, to be beset with difficulties "so numerous and so baffling, that there is no reason to hope that they will ever be fully overcome." In many cases too, the reduction, even if correct, implies an accumulation of air in places where no air exists, and isobars so drawn, traversing mighty mountain ranges, such as the Rocky Mountains or the Himalayas, or elevated plateaus, such as those of central or Eastern Asia, convey an impression which may easily lead to serious mistakes. The great achievement of the year is unquestionably the gathering in of the observations taken, by international agreement, at nine Arctic stations, in which, amidst circumstances of more or less discomfort, parties continued through a full period of twelve months. With one station established by the United States, on the shores of Lady Franklin Bay, it has been found impossible to communicate; this was established in the summer of 1881, and no trustworthy news has since been received. Preliminary reports have been published from the English station at Fort Rae, on the northern shores of the Great Slave Lake; from the German station in Cumberland Sound; from the Austrian at Jan Mayen, and from some of the others; but the principal interest attaches not to the observations taken separately, but to the collation and comparison of the whole, which may be expected to lead the way towards problems of the greatest importance to Meteorology. In the present day, one science is so mixed up with a number of others, and so involved in them, that it is impossible to separate them, or to define the exact limits of each. Many of the problems of meteorology belong as much to geography, or at times even to experimental physics, and an address which speaks of the progress of meteorology is, perhaps, apt to appear in some degree discursive. It is that the true student of nature, whilst limiting his detailed work to one particular direction, must consider her kingdom as a grand and comprehensive whole, one and indivisible.

A Negative Thermometer.—The ordinary mercurial thermometer is, as is well-known, based on the dilatation of bodies by the action of heat, and on the difference of dilatation between mercury and glass. A new thermometer in which the mercury column sinks with a rise of temperature, has moreover, been introduced by M. D. Latschinoff, who has based his instrument on the discovery of Kohlrausch that the coefficient of dilatation of ebonite is greater than that of mercury. Latschinoff has made the reservoir of his thermometer of ebonite, and the result is that the level of the mercury falls in it when the temperature rises, and, on the contrary, rises when the temperatue falls. A rise of 20° Cent. lowers the mercury 25 millimetres. The result is curious; but ebonite is so untried a substance for thermometry, that we may be permitted to doubt if it will give accurate and constant indications with lapse of time.—*Engineering*.

SCIENTIFIC NEWS.

FROM *Dun Echt Circular*, No. 83, we learn that Prof. Krüger, of Kiel, has telegraphed a message received from Melbourne, announcing the discovery of a small comet on January 12, in R. A. 22h. 40m. and S. Dec. 40° 8′ moving rapidly south-east. The circular notes that unless some error has been made in transmitting the message from Australia, the comet does not at present seem likely to become visible here.

A curious announcement recently appeared in the *Times* to the effect that Dr. Gould, of Cordoba observatory, had telegraphed to Buenos Ayres on December 15, his discovery of five comets, all small ones! One of the Buenos Ayres newspapers thinks they account for the extraordinarily hot weather experienced in the region of the River Plate, and we suppose also for the equally extraordinary cold weather experienced in Georgia and Louisiana.

The Cunningham Medal of the Royal Irish Academy was awarded to Mr. John Birmingham, of Tuam, at the meeting held last week, when the president, Sir S. Ferguson, F.R.S., gave a brief description of Mr. Birmingham's labours in cataloguing coloured stars. "The Red Stars" was published in the *Transactions* of the Academy in 1876, and Mr. Birmingham is now engaged in revising and supplementing the lists, so as to bring them up to the present time. The Rev. Dr. Haughton characterised Mr. Birmingham's work as a unique and important contribution to science.

In the course of a Gilchrist lecture delivered last week at York by Prof. Ball, on "The Moon and her Volcanoes," the lecturer said that perhaps the most philosophical conclusion was that throughout space there might be life adapted to existing circumstances, as was the case over the face of the earth.

From the *Abstracts of Proceedings* of the Liverpool Astronomical Society we learn that observational work has been divided into seven sections, and that volunteers are coming forward to assist in the practical work. The latest instalment contains a paper by J. E. Gore, F.R.A.S., on "Chi Cygni," with a lithographic chart of the vicinity. The Rev. T. E. Espin also gives an account of observations made during the late maximum of that variable, while Mr. Sawyer, of Cambridgeport, Mass., contributes a note on the "Variable R Leporis." Amateurs who are desirous of doing real work with the telescope, cannot do better than become members of the Liverpool Astronomical Society, or, at least, join in the labour of one of its sections.

Prof. Flower has accepted the post of superintendent of the Natural History department at South Kensington, vacant by the retirement of Prof. (or Sir R.) Owen, and the Royal College of Surgeons will consequently have to elect a conservator of their museum.

Mr. Clement L. Wragge arrived in South Australia on Dec. 6. He has made a number of meteorological observations, and when passing through the Suez Canal he collected a large quantity of marine shells. While crossing the Australian Bight a thunderstorm occurred, and the self-recording barometers showed that there were two distinct storm centres.

It is stated that nearly sixty lamps have been sent in to compete for the prize of £500 offered by Mr. Ellis Lever for the best safety lamp. They come from various parts of the Continent, America, and the United Kingdom. The apparatus erected at Woolwich by the Royal Commission on Accidents in Mines will be placed at the service of the adjudicators as soon as the experiments conducted by the Commission are over; but it will necessarily be some time before the award, if any, can be made.

A remarkable "recovery" is reported from the neighbourhood of Whitstable in the person of a woman, who for twenty years had lain in a helpless condition and had become "quite black." Her brother was recently sentenced to imprisonment, and on hearing of the sentence the woman suddenly regained her normal complexion.

At a meeting held at the Parkes Museum last week, Mr. T. P. Teale, of Leeds, delivered an address on the economy of coal. Instead of a solid bottom of fireclay or iron, Mr. Teale incloses the ashpit in such a manner that little air can reach the fire beneath the grate. By this means, it seems, the coal is reduced to a fine ash, which falls through the grate, and the poker is not required. The stove is all the better if the back and sides are made of thick fireclay, or if an arch of fireclay be arranged to interrupt part of the ascending heat.

In our *résumé* of "The Progress of Astronomy in 1883," on p. 375, we remarked, apropos of Dr. Huggins's supposed photographs of the Solar Corona, obtained from the uneclipsed sun: "It is now suspected that the pseudo-coronal structure visible in his negatives may have its origin in reflection from the dark backing of his photographic plates, such backing being painted on with a brush." In connection with this paragraph we have received a letter from Dr. Huggins himself, couched in terms so strong that we are persuaded that he would modify them on reflection. In no existing scientific periodical has more ungrudging testimony been rendered, or more ample justice done, to the imperishable work of Dr. Huggins in Celestial Physics, than in the ENGLISH MECHANIC. The very words in which his name is introduced, in the paragraph to which he takes exception, as that of "our greatest living English spectroscopist," might surely have convinced any reasonable man of our earnest desire neither to underrate him nor his work. We have not, ourselves, seen any of his photographs, but founded what we wrote on information derived from a gentleman who had himself examined some of Dr. Huggins's earlier negatives; which —in his opinion—showed indubitable traces of reflection from the backing of the plate. That we were mistaken in our supposition that such reflection arose from *brush*-marks, however, is evident from the fact that we have Dr. Huggins's own assurance that the varnish was spread with a flat wooden spatula. That the main rift in the Corona, visible on a plate taken during the total Solar Eclipse, is also seen in three of Dr. Huggins's negatives, affords, *pro tanto*, proof of the objective reality of his photographs: but until such reality is demonstrated, we venture to think that the origin of the seeming coronal structure on his plates "may" be "suspected," without justifying the strong language which Dr. Huggins has thought fit to address to us.

The "cold wave" in America seems to extend over a very wide area, and for certain parts the temperatures recorded are unprecedented. In the first week of January, the following temperatures were reported:—48° below zero at Jamestown, Dakota; 27° below zero at Chicago; and 20° below zero at Louisville, Kentucky. The temperature at Mobile on Jan. 6 was as low as 20° above zero, and the whole crop of spring cabbages is believed to have been lost. The last statement serves to indicate that no mistake has been made about "zero." At Charleston, S. Carolina, which is in about latitude 30°, the thermometer on the morning of Jan. 6 registered 13° above zero, the coldest weather known there for 135 years. In some of the Northern States the temperature has been reported as more than 40° below zero; but no particulars of the thermometers used are at present forthcoming.

In moving the adoption of the annual report, the Chairman of the Metropolitan Railway said that during the past ten years the company had carried 600 millions of passengers without an accident more serious than a fall on the platform or a pinched finger. During those ten years 3,000 deaths had been caused by carriage accidents in the streets of London.

THE Bill promoted by the Channel Tunnel Railway Company will not be presented for Parliamentary sanction next session. The South-Eastern Railway (Channel Tunnel) Bill is to be proceeded with.

A MECHANICAL absurdity recently announced is a steam-engine with two curved cylinders. This, of course, requires curved pistons and rods, which are connected to cross heads that are required to transmit the power on a straight vertical plane. The obstacles to this are overcome by a complicated mechanism having some relation to a parallel motion. If the intention of the inventor was to see how complicated he could make a simple machine, he has been tolerably successful: but if it was to make a steam-engine for practical use, it is difficult to see that he could have more effectually contrived how not to do it. This engine will probably be described as of "simple design."—*American Machinist*.

Sunday and Monday evenings, January 20 and 21. On Sunday it was observed at 5.30, notwithstanding the prevalence of a ruddy sunset afterglow; and on Monday evening it was observed amidst the gaslights of the city from 6.30 till 7 o'clock.

I have just been conversing with a gentleman who distinctly remembers this comet in 1812.

T. P. Barkas.

BLUE MOONS.

[22269.]—While observing a planet (supposed to be Venus or Mercury, or some of that lot) during one of the late rosy sunsets, it struck me that the recently described blue moon was a gigantic natural fraud, and at the best but a poor imitation of that beautiful and original artificial phenomenon first discovered by a well-known soapmaker, and so prominently brought before the public by means of his advertisement.

A. C. M.

"ASTRONOMICAL NOTES."

[22270.]—In consideration of the number of subscribers that you have in the United States, Canada, and, doubtless, other distant parts of the world, would it not be possible for you to insert the "Astronomical Notes" for each month in an earlier issue of the paper than at the present time. Thus your subscribers here would have the benefit of a whole month's Notes, instead of a little more than half a month as at present. "Astronomical Notes" for December appeared in the issue of Nov. 30th, and I have not yet received, nor do I yet expect those for January. Can you provide for your distant subscribers, who esteem your paper so highly? If so, you would gladden our hearts.

Chas. Bowden.

526, North Second-street, Camden,
New Jersey, U.S.A., Jan. 4.

[We fear we cannot. With our world-wide circulation, our "Astronomical Notes" must necessarily be only locally of use. If we consulted the convenience of our American readers—and nothing would give us greater pleasure were it possible—why not those in New Zealand and China, in Nova Zembla and the Falkland Islands? To do that, we should have to devote several pages a week to "Astronomical Notes."—Ed.]

MICROSCOPIC MOUNTING.—VII.

Staining.

[22271.]—I. *Staining in General.—Transient Stains.*—The use of microscopic staining (which is only dyeing on a small scale) is, as distinguished from its mere prettiness, to render objects more distinct and help us in discriminating one tissue from another by their being affected in different ways. It is consequently advantageous not only to employ permanent stains for mounting, but also to apply quickly-acting though transient staining fluids in fresh examination. The transient stains are, briefly: iodine, magenta, sulphuric acid, sulphuric acid and syrup (Schultze's test, and Pettenkofer's test for bile), nitric acid, and acid nitrate of mercury (Millon's test: colours nitrogenous, or, in other words, albuminoid matters, red). Fresh examination ought never, of course, to be neglected; just as whatever is examined with the microscope ought, if large enough, to be previously examined closely with the naked eye, and torn, cut, &c., in various directions to see what its make is. Fresh examination is requisite, if only to show what there is in the object to be brought out by appropriate processes of mounting, and a very much more real and practical acquaintance with objects may be gained by fresh examination and mounting combined, than can be expected to be acquired by mere inspection of mounted specimens. Here, however, we have to do with mounting, and consequently with permanent stains. These are (1) metallic impregnations; (2) carmine and hæmatoxylin; and (3), the aniline and phthalein dyes, in going through the first of which we can include the necessary explanations on the *rationale* of staining.

II. *Metallic Impregnations: Diffuse, Bioplasmic, and Special Tissue Stains.*—Stains appear to act in three ways—firstly, they get in, and colour because they cannot get out—quite independently of any special affinity they may or may not have for the tissue acted on, and simply on account of something having been done which fixes them within it. For this reason, tubes, &c., are often highly coloured; and aniline dyes penetrate into the xylein and bast portions of vegetable sections, and into the interior of thick-walled epidermic cells—wherever there is a thick cell wall, in fact—and have not time to escape through subsequent rinsing with spirit before they are arrested by oil of cloves or some other medium. Magenta, however, like carmine, is a bioplasmic stain. So, again, by penetrating a tissue with a dilute solution of sulphate of iron (green copperas); and following this up, after imperfectly washing the object, by a dilute solution of pyrogallic acid, an exceedingly fine precipitate of what is, in reality, black ink, will be produced within it (*Dr. Frances Hoggan's method*), giving a neutral tint, which produces distinctness, or may serve as a background for other stains. *Prussian blue* may also be formed in the interior of the object by penetrating it with a dilute solution of yellow prussiate of potash, and after imperfect washing, following this up by a dilute solution of perchloride of iron; but wherever prussian blue is used, the object must not afterwards be exposed to alkalis. In these cases it is plain that the stain is formed simply because the fixing agent penetrates before the agent which it fixes has escaped: and any difference of staining must be due to difficulties of escape caused by thickness of cell-walls, tubular or other recesses, thick or syrupy cell contents, or crannies, joinings, or irregularities of surface, by which the stain is detained. This merely physical or mechanical factor is more or less operative in all staining; and the *rationale* of many apparent irregularities will be apparent if it is borne in mind. *Molybdate of ammonia* also gives a neutral-tinted background. *Nitrate of silver* has but little power of penetrating tissues; but it has a special liking for the slight irregularity produced by the junction of surface cells, which it is therefore used to render conspicuous. A 10 per cent. solution (a drachm to an ounce and two drachms *of distilled water*) may be made when required, and diluted as necessary (with 4 to 40 parts of distilled water). The object darkens on exposure to light (better with a little salt), and the solution must be kept in perfect darkness, the bottle being covered with blackened paper, with black varnish, or both.

Another way in which stains act is through the albuminous matter in the tissues, operating as a more or less feeble mordant, or, as a substance which absorbs the dye more than the others, and is inclined to retain it when the others give it up. This happens more or less with most stains, and especially with perchloride of gold, osmic acid, carmine, and hæmatoxylin; it is probably partly physical, due to the gluey nature of the albumen. White of egg is nearly pure albumen and water; but as albumen is also used as a mordant in dyeing, it is also, at least in many instances, partly chemical: and it is of great importance in microscopical staining, for albumen is one of a closely-related group of very complex, readily alterable, and easily coagulable substances—blood albumen, egg-albumen, vegetable albumen, fibrin, casein (the coagulable principle in milk), &c.—from which the other bodies formed in animals and plants are constructed. The albuminoids exist diffused through the juices as the albumen in the fluid, as distinguished from the corpuscles of the blood; but the celebrated protoplasm or bioplasm is an individualised, semi-solid, moving albuminoid. Hence stains, in so far as they are mordanted by albumen, are specifically bioplasm or protoplasm stains. While, therefore, molybdate of ammonia or ink formed within the object are diffuse stains or non-discriminating general backgrounds, perchloride of gold, osmic acid, &c., are bioplasm stains.

Perchloride or Terchloride of Gold is a yellow salt sold for photographic purposes in glass capsules, each containing fifteen grains, so that if the contents of one of these capsules be dissolved in three ounces of water, a one per cent. solution will be formed, than which nothing stronger will be needed. Gold is used to the best advantage on fresh objects; and though it will often stain those which have been hardened in alcohol, or even in chromic acid, it sometimes refuses in the most determined manner to have anything to do with them. Like other bioplasmic stains, it acts more rapidly and intensely in proportion to the quantity and activity of the bioplasm present (though the question of "could get in and could not get out," has to be considered); stains animal more than vegetable objects; in summer than in winter; and in warm than in cold weather. With leaves and other parts containing chlorophyl it gives a dirty disagreeable tint (hæmatoxylin, also purple, is here better); but may be used for the other parts of plants, and, among animal tissues; stains best mucous tissues, glands, the skin, nerve, muscle, and cartilage *cells*. Its normal colours are blue, various shades of purple, ruby-red, and brick-red, all of which may be seen in the same section. For instance, as anything is stained which throws down the gold, black-blue blurs often indicate in plant-sections the position of latex vessels or other cavities containing special products. It frequently abstains from staining the nuclei, which may then appear green by contrast; and, even in very dilute solutions (·003 — ·006 p.c.), exercises a hardening effect on the protoplasm, without, apparently, contracting or otherwise changing it. But, *as with other stains*, the effects of the other reagents which may be employed along with it have to be taken into account.

To stain with gold, the objects, after having been washed clean from any adhering matter, may be immersed in a very weak dilution of acetic acid (·05 — ·5 p.c) till it has penetrated throughout, which it will do in an hour or less according to their bulk and density. They are then to be put into a gold solution (·02 — ·5 p.c.), and left there till they assume a yellowness distinct from that of the solution in which they lie (ten minutes to two hours). On removal from this they must be thoroughly well washed, so as to remove all superfluous gold; after which they may be immersed in concentrated solution of tartaric acid or acetic acid, 1 per cent. or so, or hydrochloric rather weaker; and exposed to as bright daylight as possible, to develop the permanent colour. Solution of sulphate of iron has been also recommended, but I think hydrochloric acid is chiefly used, and the iron has in my hands given rise to a disagreeable smoky tint. The permanent colour appears in a few hours, at first, perhaps, in patches; it often darkens with each change of fluids, and if not allowed to develop itself fully before mounting, does so afterwards, so that some of the sections or other objects may finally become so deeply stained as to render them useless. To guard against this, expose the objects to light from the first application of the gold up to the final mounting, which may easily be done by placing them in a mounting pot, or a watchglass with a glass circle over it; do not hurry the mounting; cut the sections as thin as possible, so that there may be less thickness for the gold to stain; and, as directed above, wash the residual gold solution thoroughly well out. Another plan is to leave the objects in the gold solution till the final colour has fairly developed itself, and then wash; but this may give rise to a speckled or dirty look, arising from irregular precipitation. This look may also be due to the use of too strong solutions, and the addition of glycerine to the liquids tends to prevent it. Their action is slowed by the glycerine, but this may be corrected by the addition of a little spirit. A third way is to render the objects slightly alkaline by steeping in diluted *liquor potassæ*, then just to immerse them in water with a little acetic acid to correct surface alkalinity (which might cause a cake of gold precipitate to form on their surface), and then to let them lie in a gold solution. The gold then gets in and cannot get out, being precipitated by the potash, or a deeply staining double chloride of gold and potassium may be formed. Insect structures cleaned by *liquor potassæ*, as the pad on the foot of a fly, may be thus stained; but the method first given is the orthodox one.

Osmic Acid, which is usually obtained in a 1 p.c. aqueous solution sold at the very high price of a shilling a drachm (with a reduction on taking a quantity), is volatile, and must be covered while acting, has a strong smell somewhat resembling that of chlorine, and very irritating to the eyes and nostrils, and stains yellow or grey, passing into black. It is much easier to manage than gold, because though with it also the colour intensifies (especially if it is not well washed out after staining), the final colour is merely an intensification of the first. It stains very much like gold, except that it blackens fats and tissues which, like nervous tissue, contain a considerable amount of fatty matter, and also resembles gold in the circumstance that dilutions of very different strengths have to be used on different occasions. The fainter stains are better than the very deep ones, which are apt to be blotchy, mottled, or granular, so that as weak a dilution as will stain should be employed; and sometimes only a drop or two of the 1 p.c. solution to a couple of drachms of water will be sufficient. As in other cases, the addition of glycerine moderates the action, and tends to prevent the specks or blotches. Osmic acid is also a killing, a hardening, and a preserving agent, and, as it thus kills four birds with one stone, has been much used on very minute and very delicate objects which will not bear much handling or many transfers of fluid—such as embryos, minute polyps, and specially alterable components of higher organisms. Staining minute objects also renders them more visible. It is advisable not to mount the preparations at random in glycerine, as the colour then sometimes vanishes altogether or in patches. Small water worms, stems to which vorticellæ or bell animalcules are attached, &c., may be placed with a little water in the cell in which they are to be mounted; to kill them, the 1 p. c. solution may be gently applied by means of a small tube, and the objects washed with water as they blacken. They may thus be seen sometimes with their cilia extended; the cilia on the gills of a fresh-water mussel become very apparent. On the other hand, the animal may have time to withdraw its cilia, tentacles, &c., before dying. Whether it will do this or not will depend partly, perhaps, on its being hungry, and partly on the thinness and permeability of its integument and the rapidity with which a sufficiently strong solution of the acid is brought into contact with it, without contraction being previously induced by (e.g.) the plop or shock of a *drop* of osmic acid against the water. Apply, therefore, in a continuous current from the tube. Like osmic acid, *Picric acid* also kills, hardens, preserves, and stains (the stain being yellow), so that it may be here noticed, though not a metallic impregnation, nor a dis-the train in question. And here I think we may get a practical use of the h.p. of an engine, for by its aid we can calculate the rate at which an engine will take a train up a known gradient.

The horse-power used against train resistance is given by the expression

$$\frac{120284\ Wv + 88\ Wv^3}{3762000}$$

using Mr. Luis' formula. The total work done in going up a gradient of 1 in m. is given above, and we therefore have the equation

$$\frac{120284\ Wv + 88\ Wv^3}{3762000} + \frac{197120\ Wv}{33000m.} = P.$$

where P is h.-p. From this we get $3{,}969{,}372{,}000\ Wvm + 2{,}904{,}000\ Wv^3m + 741{,}568{,}440{,}000\ Wv = 124{,}146{,}000{,}000\ mP$, in which v is supposed to be the unknown quantity. This equation is a cubic with its second term missing, and may be solved, after putting in the known values of W, m, and P, and suitable reduction, by Horner's method of continual approximation. It must have at least one real root, although the other two may be imaginary. I cannot agree with Mr. Gobert that the h.-p. is (necessarily) very variable during a journey, and think I have pointed out the fallacy upon which the statement is based—i.e., neglecting the work done in ascending inclines. I will esteem it a favour if he will send Hrabak's formula, to which he makes reference, and shall be glad to learn his views—versus "Historian"—as to locomotive designing.

Elswick Science School. **Wm. John Grey.**

[22277.]—THE latter part of Mr. Gobert's letter (22254, p. 429) furnishes so completely the information for which Mr. Grey asks, that it seems perfectly unnecessary for me to take up valuable space by simply giving similar facts.

There is no doubt that work done can be expressed in terms of horse-power by multiplying the total resistance in pounds by the velocity in miles per hour, and by the constant number 2·66, cutting off five figures from the right-hand of the product for decimals; the remainder is the effect in terms of "horse-power."

As I have before said, the power of locomotives is not calculated by horse-power on account of the "uncertainty." I agree with Mr. Grey, that "knowledge is amply worth having,"—that is, if it be useful and practical; but it appears to me that to obtain formula about which "uncertainty" exists, and, as Mr. Gobert truly says, "cannot be depended upon," is a kind of knowledge which may do great harm by misleading the young engineering student; therefore, I hope the expression "horse-power of locomotive" will henceforth find no place in the columns of the ENGLISH MECHANIC.

Mr. Gobert, in my opinion, does not calculate the resistance high enough for practical everyday working: the formula $R = 8 + \frac{v^2}{171}$ was given in your XXIXth Volume, p. 92, and is all very well for experimental trains in good order. Mr. D. K. Clark, in his "Locomotive Engineering," p. 290, states that resistances calculated by this formula "should be increased 50 per cent., or one-half more."

Now, in looking over Mr. Gobert's formula, I do not see that he increases his results by 50 per cent., as Mr. Clark in his book tells us must be done for daily working, and he uses formula $R = 12 + \frac{v^2}{114}$, which I find very correct.

Experiments were made at Newark to determine the resistance of trains, and I should be glad to know the highest and lowest constant resistance per ton then obtained, in order to compare it with recent experiments.

In conclusion, it may interest your readers to know that on the Manchester and Derby line (which has many curves) trains made up of bogie carriages and cars are running with *two pounds per ton less resistance* than trains of the same weight and same speed, when made up of four or six-wheeled coaches. This fact is one of importance, and appears to confirm an opinion which Mr. Stretton expressed in your columns of April 4th, 1879. With the present heavy express traffic, it is, above all, necessary to reduce the resistance per ton.

Historian, M.I.M.E.

COMPOUND ENGINES.

[22278.]—FROM the number of letters that have appeared in your valuable paper on the above subject, there appears to be much interest taken in, and a great diversity of opinion with regard to, the benefits derived from compound engines in comparison with the single-cylinder engine. I should take it as a great favour if "Engineer, Dewsbury," would kindly show what amount of power he would derive from his compound engine with the receiver placed between the two cylinders, and working with the cut-off as laid down in his first formula? Also, what would be the capacity of the receiver he would use.

Bradford, Jan. 19. **Young Engineer.**

[22279.]—IN reply to "Engineer, Dewsbury" (letter 22253), I did not misunderstand my informant respecting the lead of the pistons. I have many times seen them as stated by "Engineer," the low-pressure leading, notably in the compound engines made by Messrs. Galloway and Sons, Manchester. But the party I mentioned expressly states that the high-pressure was leader, and by only a few inches, and some diagrams I have seen appear to bear out the statement.

Its being out of common practice was my reason for asking an opinion upon it.

Celeriter et Fortiter.

THE MANUFACTURE OF ALUMINIUM.

[22280.]—MR. GREY'S figures (22264) are no doubt correct; but it would have been as well had he taken the advice he quotes, and not rashly declare a thing impossible because he cannot accomplish it himself. Facts speak for themselves. A salt of aluminium has, and can be, reduced by sugar. This is carbon in a peculiar form and combination, and it is very probable that no other form of carbon, except a multiple of the formulæ ($C_{12}H_{22}O_{11}$), would have the like effect.

A. E. S.

A HAND-WARMER FOR PIANISTS.

[22281.]—WITH reference to the letter (22210) of your esteemed correspondent, Mr. W. H. Davies, I perfectly recognise the value of the warning he gives, but am happy to say that the little apparatus mentioned in my former letter (22247) is not in any way open to the objection mentioned, it being adjusted *outside* the piano, immediately in front of the keyboard. I have now used the hand-warmer for two winters, and do not find it at all in the way of the knees, as it comes some little distance above them. It is a true, if not an elegant, saying, that "the proof of the pudding is in the eating," and I may remark, generally, that I have found this apparatus most satisfactory in every way, and I certainly do not see the slightest drawback in it. At the same time, I should be very pleased indeed, as would also, no doubt, a very large number of your other readers, to know whether any other hand-warmer has been seen, or used, or heard of, by any of your musical correspondents. With regard to the suggestion of Mr. Davies, that the best plan of warming the hands is to give them a good exercising for five minutes with scale practice, I can only trust that Mr. D.'s experience in this matter has been less bitter than my own, for I have the most vivid recollections of many and many a time, when my hands and fingers have been so thoroughly numbed and cramped with the cold, that scale practice, or any other practice, was simply impossible.

W. Ritchie.

OIL GASWORKS — COILS AND PARAFFIN PAPER—PARAFFIN LAMPS AND BURNERS—ELECTRIC BELL—FISH-GLUE — WATER-CISTERNS — MURAL DECORATION — RE-COVERING SILVER—TONING PRINTS.

[22282.]—Do I understand Mr. James Copcutt (22263) to say that the gas made from oil by his retort can be preserved in a gasholder? and can he say how much gas will be made from a gallon of petroleum oil? Will it keep without condensing as well as ordinary coal gas? As there can be no question about its being better than coal gas, even if we don't think of anything but the sulphur. Mr. C. offers more information. I certainly should like to have it, as the apparatus could be fixed at the back of the kitchen fire, and the gasholder in the coal vault. Is there any danger of the back pressure forcing the oil out of the tube and funnel?

I did not answer Mr. B. Harcourt's reply to my letter on coils, as I have never tried the method he suggested: but it seemed to me like putting two coils together, joining the cores by an iron cross-piece at the back, and using one contact breaker. He will never be troubled with his paraffined paper cracking if he makes it according to my method. Use fine white tissue paper, not the straw-made stuff that drapers use. If it cracks, there is too much paraffin.

My oilman tells me that the burners of paraffin lamps will not burn properly when they get old, but he cannot tell why. Perhaps some correspondent may be able to say why this is. It is not to save the few pence for a new one, but I am rather curious to know why a burner, with seemingly nothing the matter with it, should cease to give a good light. The same oil burns in another lamp, but this one goes down to nothing shortly after it is lighted; it is not the wick nor the oil which is in fault. While on this subject I should also be glad to be informed how much positive advantage a five-wick burner has over a burner with one wick (for lantern purposes), supposing the one wick to be as broad as the combined wicks placed side by side? The one wick presents a larger surface both to the condenser and to reflector, as there are no interspaces, which must be between the five wicks. I can imagine two wicks placed at an angle giving a little more illuminating surface. I don't think table lamps, with two 1in. wicks, give as much light as one 2in. wick would do. The illuminating portion of a flame seems to me to be very opaque, and I don't think the light from one goes through the other. Mr. Fletcher will, I hope, throw a little light on the subject.

"Chemicus" (52739) will find the bell he wants rather a complicated affair; as, if he wants it to ring a certain time and then leave off, he must have something in the shape of clockwork, which is wound up by the opening of the door—that is, if he requires it to be perfectly automatic; but if any one has to attend when the door is opened, the affair could be arranged with a minimum of personal trouble. The door could be made to turn a lever completely over, and thus make contact. This would have to be turned back by some mechanical action, controlled by a wire, and actuated by the attendant as he entered the room or shop; or a peculiar form of relay could be used, to be stopped by hand. But if the bell is to stop itself, something must be used which will require to be wound up. Any of these methods would be easy to a practical mechanic, as a clock can be easily made to run a certain time and then stop till restarted. The essential parts would be a spring, some kind of governor, a wheel with an arm to lift off the lever, and break contact, also a stop to be reversed by the opening door. Leclanché battery is the best. Porous cells are about 6d. each, and trying to do without one will cost more in the end, and you can't get a really good form of battery without them, or they would not be used. A bladder can be substituted.

If the American fish-glue (52697) is such "wonderful stuff," why does not "Architectus" send the recipe to the "E. M.," instead of asking the correspondent to advertise his address? It is the very thing we want—"costs nothing and is invaluable."

The cause of trouble in "Engineer's" water-cistern consists in the fact that if it is a new one it has not been completely coated with zinc, and the iron rusts through the spots. In this case, coating of zinc is a positive injury (but a negative element), as it sets up a galvanic action; the oxide of iron is forced through the hole in the zinc, and spreads itself out on the surface, and, of course, comes off with the least motion of the water. If the cistern is an old one the cause is the same, as the coating of zinc, however perfect it may be, is thin, and won't last for ever. The remedy, as Mr. P. Ward says in one of his replies, "is obvious."

I am delighted to see ladies reading the "E. M.," and still more so to see them writing for information; but it is only another proof (if one were needed) of the increasing value of our wonderful journal. I am sorry I don't know much about mural decoration (52623), but I think distemper colour is mixed with water. What "E. C. N." wants is called "flatting." The colour is mixed with turpentine, and it has just sufficient boiled linseed oil added to it to prevent it from being rubbed off, and not enough to give it that glossy appearance which paint generally has; if properly done it can be washed *ad lib.* The walls must be smoothed with pumice, and each coat of paint the same except the last, and the paint itself should be strained through coarse muslin.

To recover silver (52751) from iron which has been plated, I should file off the silver, preserve the filings and dissolve off the iron with dilute sulphuric acid. If the iron has not been coppered, the silver will be pure after being well washed. If there is copper it must now be dissolved in nitric acid, and clean pieces of copper placed in the solution; the silver will be reduced on the copper, and may be shaken off into water, washed, and dried. It is as well to neutralise the acid solution with soda or ammonia, stirring well after each addition, and add no more on the appearance of a precipitate. If this is not done, the uncombined acid will dissolve more copper.

52794 has no business to get any red colour with his prints at all. He evidently tries to tone them, after fixing. Take the prints from the frame, wash them, tone them, and then fix; there will be no red colour to get out. Toning bath—sodio-chloride of gold, 2gr.; carbonate, acetate, or phosphate of soda, 30gr. This will tone a sheet of paper. Use warm.

Os.

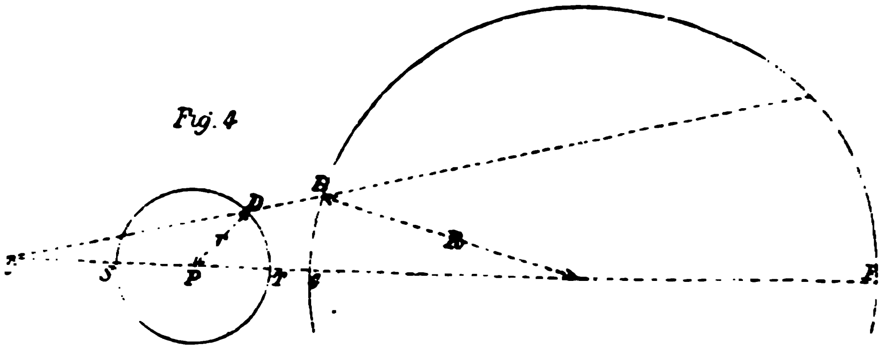
LINKAGES.

[22283.]—IN the following notes I have attempted to explain systematically, and by elementary methods, the simplest ideas of the most important theory of linkages. I must acknowledge my great obligations to Kempe's "How to Draw a Straight Line."

1. Let ABCD be a rhombus which has its side

[illegible]

Fig. 4



line, in the same sense as a pair of compasses gives a mathematically exact method of drawing a circle. It has already been adopted in machinery to replace such devices as Watt's parallel motion, which are used to make a certain point in a machine—e.g., the end of a piston rod—move backwards and forwards in an approximately straight line.

[illegible] If the centre of inversion (O) be not on the circumference of the circle described by the point D then it may be proved that the point B will describe a circle instead of a straight line. Taking this result for granted, we may find the size of this circle, as in the following section.

[illegible] To find the radius (R) of the circle, which is the inverse of a given circle, radius = r, for different positions of the centre of inversion (O).

Let the points F G correspond to the points S T. And [illegible] OS . OF = OT . OG = k.

$$OF = \frac{k}{OS} \text{ and } OG = \frac{k}{OT}$$

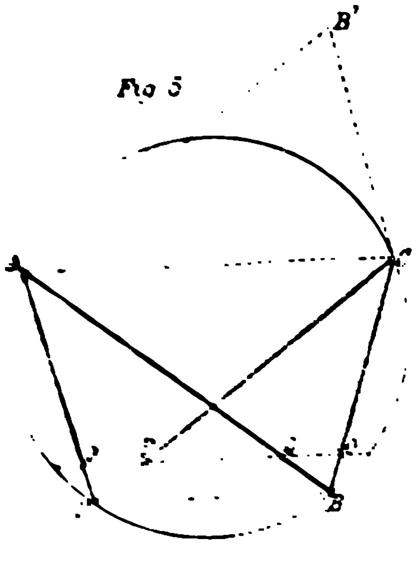
$$2R = FG = OF - OG = \frac{k}{OS} - \frac{k}{OT} =$$

$$\frac{k(OT - OS)}{OS . OT} = \frac{k . 2r}{OS . OT}$$

$$R = \frac{k r}{OS . OT} = \frac{k r}{(OP + r)(OP - r)}$$

Now from [illegible] we see that k = $OA^2 - AD^2$, and is therefore determined by the dimensions of the cell.

Fig. 5



[illegible] link FD. Therefore [illegible] OP we can make the [illegible] any required size, and [illegible] the greater will [illegible] gives a useful practical [illegible] of very large [illegible] curves, such as are re[illegible] engineers' and [illegible] seen that only a [illegible] of the circle F G [illegible]

[illegible] four links [illegible] figure at A. [illegible] C B, they will [illegible] be turned [illegible] then we shall [illegible] hence the [illegible]

[illegible] have their sides [illegible] therefore, equal in [illegible] A C is parallel [illegible] however the [illegible] = [illegible] D C B, therefore a circle may be described so as to pass through the four points A, B, C, D.

12. To prove that, if the four points O, P, Q, O¹ be taken, dividing the links D A, D C, B A, B C proportionately, O, P, Q, O¹ will remain in a straight line.

For ∵ D O : O A = D P : P C, ∴ O P is parallel to A C (Euc. VI. 2). Similarly O Q is parallel to B D, which is parallel to A C. Therefore O P and O Q coincide, i.e., O, P, Q are in the same straight line. Similarly P, Q, O¹ are in the same straight line. Therefore all the four points O, P, Q, O¹ are in the same straight line, which remains parallel to both A C and B D.

13. To prove that rect. A C . D B = constant.—∵ A C B D is a quadrilateral inscribed in a circle. ∴ rect. A B . C D = rect. A C . D B + rect. A D . C B (Euc. VI. D). But A B, C D, A D, C B are all constant, being links. ∴ rect. A C . D B = const.

14. To prove that rect. O P . O Q = constant.—By similar Δˢ, O P : A C = O D : A D, and O Q : D B = O A : A D. Therefore O P . O Q : A C . D B = O D . O A : A D². ∴ rect. O P . O Q = (A C . D B) × (O D . O A) ÷ A D². But A C . D B = const. by § 13, and O D, O A, A D are all constant: ∴ rect. O P . O Q = const.

15. Hence we see that if the point O be fixed, P, Q will describe curves which are the inverse of one another. This linkage may, therefore, be used in the same way as Peaucellier's cell; and, besides, it is simpler by two links.

Leonard Marshall, M.A.

TELPHERAGE.

[22254.]—In your article on "Electric Railways and Telpherage," of the 14th December, you give to us the credit of having invented the "cross-over parallel" system of telpherage working. *This simple* and inexpensive method is the *invention of our co-patentee*, Professor Fleeming Jenkin.

Your article gives very clearly the principles of telpherage; but we should have liked more attention to have been devoted to the "series" system of working, for although this system requires methods of breaking and making contact at the top of each post, yet the insulation of the sections from one another when a train is bridging a post-top, does not need to be nearly as perfect as with the cross-over parallel system; a most important condition when we consider the great pulls to which the post-top is subjected.

Further, the series system enables many trains to be run by the employment of only a small total current, which is a great advantage as regards economy, since the waste of power in heating the conductor depends on the square of the current, and is therefore very large for large currents.

Ayrton and Perry.

Telpher House, 73, Great Eastern-street.
Jan. 15th.

CHESS (AN IDEA).

[22255.]—Being very fond of chess, and wishing others to become fond of it, I have often wished chessmen and boards, &c., were cheaper. Therefore, I should like to ask, Why chessmen cannot be made of earthenware or china, or even tough glass, to answer the same purpose (and as well) as the expensive ones now sold? I have never seen any made of the above named substances, and should like to know if there are such made: and if not, why not?

S. S. C.

NEW PATENT RULES.

[22256.]—The new Patents Act requires that the applicant for an invention shall make a solemn declaration, equivalent to an affidavit, that he is the true and first inventor thereof, and that it is not in use by others, thus abolishing the practice of granting patents to those who had invented nothing and for inventions already in use and well known. The Board of Trade, however, have restored the old abuses by permitting those who will not solemnly declare that they are, but will declare that they claim to be, the inventors, to use a new form of declaration that an invention has been communicated from abroad to the applicant, and he claims to be the true and first inventor thereof, and that it is not in use by others within this realm. The applicant, by using this declaration, implies that the invention had no inventor till it was mentioned to him, and that he became the first inventor by reading the account of it. Some defend the use of this declaration by the pretence that the importer of an invention is, in the eye of the law, and so may claim to be, the inventor: but no man is the importer unless he has introduced the knowledge of it into this country where it was, and but for him would have remained, unknown, which the applicant does not allege, is not required to prove, and, in fact, is never true. He is not, therefore, as he claims to be, the true, and still less the first, inventor. Foreigners are, and always have been, wisely allowed to patent their inventions here; but by this new form they may be defrauded by the grant of the patents they have earned to those who have done nothing to deserve them. That a department of Government intrusted with the administration of a law should be permitted to repeal its most important provisions would be a dangerous innovation, and probably Parliament, when the new rules are laid before it, would, on the petition of inventors and others, annul this new form and restore the law. **J. K. Smythies.**

AMATEUR MUSICAL INSTRUMENT MAKING.—V.

[22287.]—Errata in part IV. 1st. column, 13th line from foot, and top line of 2nd column, "neutral segment" should be *ventral segment*.

We now come to the metal work and keys, which are generally made of German silver or nickel silver, which is used in sheet, wire, or tube, and joined together by hard soldering with silver. The first fittings we require are rings for the sockets of mouth-piece and bell; but if the instrument is in 5 parts, we require two additional rings. Sheet metal is usually numbered by the Birmingham wire gauge, and steel wire by Stubbs' wire gauge; but I will try to give sizes likewise in parts of an inch. Half round wire is generally preferred for making rings, and as this is not easily obtained I give the following method. Take a piece of soft steel about 2in. long, 1in. broad, and $\frac{1}{2}$in. thick, and with a small round file cut a semicircular groove across it $\frac{1}{8}$in. deep and $\frac{3}{16}$in. wide at top; the block may then be hardened if desired, although this is not desired. G. S. wire, about No. 6 or 7, B.W.G. = $\frac{3}{16}$in. thick, is then beaten into this groove with a rather heavy hammer, the block being securely fixed (see Fig. 8). The wire, by this treatment, becomes hard, and must be softened by heating red hot and allowing to cool. A mandrel is then taken the size of the position of ring on clarinet, the circumference measured by a strip of paper, and allowing $\frac{1}{4}$in. for a splice joint the wire is cut rather small. The ends are then tapered, the wire bent up to a circle, a small piece of sheet solder inserted, and the joint tied with fine iron wire. A solution of borax is applied over the joint, which is then gently heated till moisture is gone, and then exposed to the blowpipe and made red hot, at which heat the solder flows. It is then allowed to partly cool and plunged in a vessel of acid, made by adding 1 part of vitriol to 4 parts water. This removes the hard borax, which sadly destroys a file; it is then rinsed in water, dried, roughly dressed with a file, put on a wooden chuck in the lathe, turned up and polished or ornamented by mill or chaser. (See Fig. 9.)

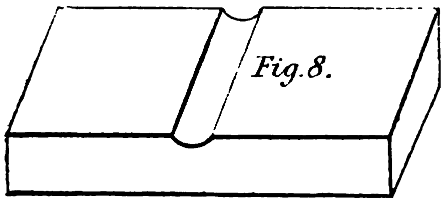


Fig. 8.

Fig. 8A.

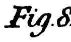
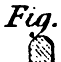


Fig. 11.



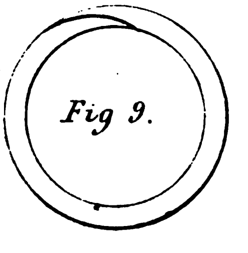


Fig 9.

Rings must be made the exact size, and before putting on are roughened on the inside with a sharp steel point, a drop of thick shellac varnish or glue is put on, and they are then gently driven to their place with a mallet. The following remarks on hard soldering may be useful. Heat always the metal near the parts to be soldered before bringing the joint to its full heat. The solder and also the metal to be joined must be quite bright, clean, and untouched by the fingers; a smoky flame must not be allowed to touch the joint. Fit the metal parts well together, leaving little or no space for the solder, as it runs very thin and will not fill up spaces. Tie the various parts to be joined well together, and if all these points are attended to failure is impossible.

For the borax solution, I shake up ground borax and a small quantity of water in an ounce bottle and apply with a small brush.

Sterling silver is the best solder, as it is not so brittle as silver solder, and this is important, as keys have often to be bent and twisted to suit their places. When two joints are close together both should be soldered at one heat; when this is impossible, the first is soldered with silver and the second with fusible silver solder—fusible solder is 2 parts silver and 1 part brass wire, or 5 parts silver and 1 part zinc. For sheet solder, I take a small silver coin and roll it out as thin as writing paper; it can then be easily cut with ordinary scissors. For wire solder, I buy some silver wire about 22, B.W.G., and draw it down to the sizes required, generally from 22 to 28, softening it by heating and cooling when it becomes hard. A gas blowpipe with foot bellows is usually employed for this work; but for amateurs the spirit blowpipe is cheaper, cleaner, and easier to manage. It may be easily made thus (see Fig. 10):—A is a tin can with flat top and bottom, about 3$\frac{1}{2}$in. diameter and 3$\frac{1}{2}$in. high, air tight, with three openings at the top—viz., B, C, D. B is closed by a cork and is used for filling it half full with methylated finish or spirit; C is closed by a cork, through which passes a brass tube $\frac{3}{16}$in. diameter, on the end of which is an ordinary blowpipe nozzle; D is a brass tube $\frac{3}{16}$in. and 1in. high outside of the vessel, with a long wick going to the bottom of the interior of A, and is used as a small lamp to keep the jet C heated and lighted. E is an ordinary spirit lamp to boil the vessel A. I think the action will be plain without description, the size of jet being regulated by the flame of lamp E. Key shanks are made of flattened wire. This is done by passing round wire of 5, B.W.G. = ·22 of an inch through rollers, or beating it on an anvil to something like the section shown at Fig. 11. Fig. 8A shows section of half-round wire used to make rings. Screws are made of steel, and as they can be bought it does not pay to make; they cost from 6d. to 2s. a dozen. Fig. 12 is a regulating screw with round head, so as not to catch the clothes or scratch the fingers; they are usually about 18 B.W.G. and $\frac{1}{4}$in. long. Fig. 13 is a general watch screw used for fastening flat steel springs, usually $\frac{1}{8}$in. long. Figs. 14, 15, 16, are all special musical inst. screws; 14 is $\frac{1}{4}$in. long: 15 and 16 are about 16 B.W.G., and vary from $\frac{3}{8}$in. to 1$\frac{1}{2}$in. long.

Small G.S tubing is also required for the joints of keys, &c. It may be made by drawing strips of metal through a number of taper holes in a steel plate, the seam being afterwards soldered; but as solid drawn tube is sold in Birmingham it is best to buy, and the size can be reduced by drawing, or widened by boring out. It must fit nicely on screws 15 and 16, and on the steel rods when required. Steel rods.—These I usually get from old umbrella frames, cleaning off the varnish with emery cloth; they are useful for making drills and special screws like Fig. 16, &c. Pillars are required of various sizes, in height from $\frac{3}{16}$in. to $\frac{1}{4}$in., exclusive of screw (see Figs. 21, 22); these can also be bought, so I need not detail their manufacture. Cups for keys are of various sizes, and cannot be bought as far as I know. Fig. 19 is the old shape used 30 years ago; 17, 18, 20, are modern. Those like Fig. 17 we will pass over, as they are difficult to make look neat, requiring great skill and practice to solder in correct position and finish nicely. Fig. 20 is mostly used as a finger key, of which we have one on the clarinet (see Fig. 5, No. 17), covering the back hole; all the rest are like Fig. 19, which has many points in its favour, and holds the pads better than in Fig 17. By referring to table in Part 4, the sizes outside are given for each one required, and as the metal is usually ·5 mill thick the sizes of inside will be 1 mill less. Five sizes in all are required; they are made from sheet G.S., about 22 B.W.G. = ·028in. thick, and are produced by stamping.

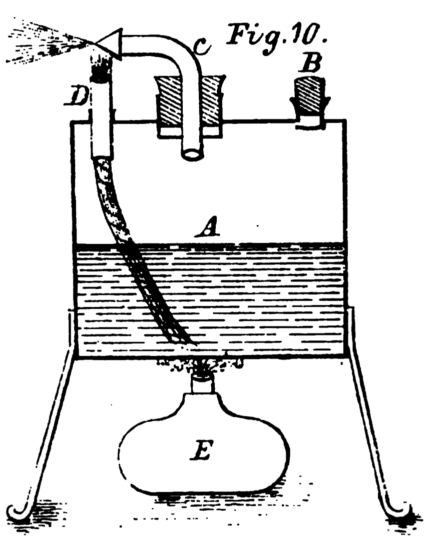
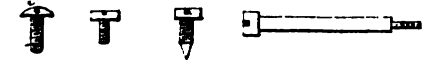


Fig. 10.

Figs. 12. 13 14. 15.



Figs. 17. 18. 19. 20.

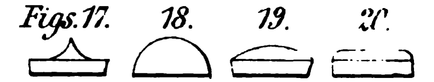
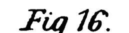


Fig 16.



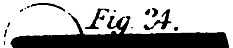


Fig. 24.

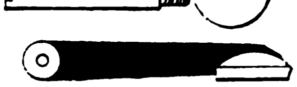
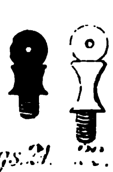


Fig. 23.


Figs. 21. 22.

11th Jan., 1884. **Vulcanite.**

WORK DONE BY A MAN IN WALKING.

[22288.]—I am not aware if this subject has ever been noticed in the valuable pages of the "E. M." We are well aware that a man does a certain amount of work in running a mile rapidly, and incurs exhaustion. But what is the actual amount of work performed? and how can we calculate it?

By a little observation we shall notice that a good walker stretches a fair equilateral at each step: taking the length of the legs at 3ft, the body is thrown forward a yard at a time, the right or left leg passing a distance of 6ft. between each lift and fall. Supposing a man to walk with all limbs perfectly rigid, the legs would go through a series of equilaterals of 3ft. base. At each stretch of the legs the distance from their centre to the ground would be 2·6ft.; and as each leg passed the other the body would be at its full height, and the distance from the centre of the legs to the ground 3ft. Hereby a series of rises and falls, each equal to ·4ft., would be incurred, the distance between each fall being 1 yard.

I need hardly say that a graceful pedestrian obviates some part of this rise and fall by such a use of the limbs as causes the impulse to be taken by the muscles, and borne as strain. Still, the actual amount of work is sustained by the body.

Now, a fall equal to ·4ft. per yard is equal to a fall of 704ft. per mile, and a man weighing 140lb. and running a mile in 6 minutes performs 98,560 units of work in the same time as a $\frac{1}{2}$-horse engine would perform 99,000.

A skilful walker sustaining 5 miles per hour for a long day does work equal to a $\frac{1}{4}$-horse engine, and consumes only $\frac{1}{20}$th the weight of food or fuel.

Guernsey Cave.

Pumping by "Suction."—A correspondent recently writing to the *American Machinist* says:—"In all theory, and in my practice, I have been led to believe that it was impossible to raise water by suction over 28ft. or 30ft., and that it was not good practice to pump it over 25ft. But my attention was called to the fact, that at a certain establishment in this city they were pumping water by suction 27ft, and having considerable curiosity, I called to investigate. The engineer stated as a fact that they were pumping water by suction 37ft., that is, from the surface of the water to the suction-valve of the pump, 37ft., with but slight variations. About 25ft. from the bottom end of the suction-pipe is a tee with nipple and elbow. From this elbow, a stand-pipe of the same diameter of the suction-pipe extends to the same height and is covered with a cap. There is a check-valve at the bottom end of the suction-pipe. The explanation is:—Fill both pipes with water, then screw the cap airtight on the top of what I should call the stand-pipe, the action of the pump will suck the water out of the stand-pipe and form a vacuum in it that will sustain the water in the suction-pipe, so that the pump will lift the water the 37ft. without any trouble."

REPLIES TO QUERIES

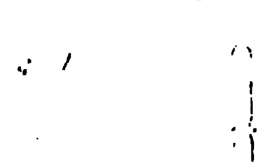
◆◆◆

In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

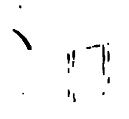
[illegible] **Cancer in the Mouth.**—I beg to [illegible] thanks to the correspondents [illegible] answered the above query. I might [illegible] of my fellow-readers, that the [illegible] "H. O'B.," Vol. XXXVIII., No. [illegible] has done more good to my friend [illegible] remedies he has ever tried.—[illegible]

[illegible]—**Metropolitan Building Act** (U.Q.)—[illegible] that an answer to this query will not [illegible] to "Horloger" now, in consequence [illegible] of time. If all the formalities re-[illegible] of the Act have been carried out, [illegible] owner is, according to Section 92, [illegible] the wie property in the party-wall, till [illegible] share is paid by the adjoining owner, [illegible] obtain an injunction to prevent [illegible] the wall before such share is paid. [illegible] should read carefully the various [illegible] of the Act.—DITTON.

[illegible] — **Soap Cutting and Stamping** [illegible] some slight idea of having read [illegible] the time it was asked; but as I pass [illegible] can only reply from recollection. [illegible] block of soap and decided upon [illegible] slabs it is to be cut into, make a [illegible] nails through a piece of wood about [illegible] thick, let the points of them pro-[illegible] and standing the gauge fairly on [illegible] scribe the soap at each corner: [illegible] means of fine pianoforte wire, a [illegible] which should have two pieces of [illegible] for handles, to afford purchase



[illegible] the soap. To cut slabs into [illegible] The handle is supposed to [illegible] where the dot is, a [illegible] and fastened to [illegible] along the slab it



[illegible] again out into pieces [illegible] and a short wire [illegible] to the air to put

[illegible] an ordinary [illegible] is wanted in [illegible] pieces, [illegible]

[illegible] way to make [illegible] with the [illegible] parts, [illegible]

engine than he imagines. I do not know whether his engine is one of his own make or purchased from an advertised firm. If the latter case, the best thing he can do is to apply to the makers, and see if they cannot help him out of his difficulty. The fault, in my opinion, either lies in the lighting parts or with "Volt" himself not having a correct knowledge of mixing the air and gas supply, which would very likely be set right in a few minutes if an application were made to the maker. If your engine is supposed to fire at every stroke, and does not do so, it is quite plain something is wrong: it should fire when the piston is at half-stroke. My engine fires at every stroke, and works in splendid style. Unfortunately, many of the small motors now offered have many things attached to them that are very troublesome to the purchaser, which obstacles will in a little time be overcome. I have a three man-power gas engine that I have had constantly working for six months (days): it is very simple in construction, with plenty of power. The engine works very steadily, at a cost of about two shillings and ninepence per week for gas—gas at 3s. per 1,000 ft. (This is the outside estimate of cost.) I sometimes work my engine from six o'clock in the morning until nine in the evening without the slightest trouble or inconvenience, so it will be seen I give it plenty to do. During the six months I have had it I have only used one gallon of oil, which is an item of great interest compared with what some engines use. My engine is one of T. B. Barker's, as advertised in this paper, although my intention in writing this is not as an advertisement; neither am I an agent, or in any way connected with that firm. I merely give information that has been asked for, which I am very pleased to be able to do, and shall be equally pleased to show any of "ours" my engine at work if they will call upon—R. STAFFORD, Craven-street, Coventry.

[52389.]—**Sulphuric Acid** (U.Q.)—The rule employed only gives correct results when no alteration in volume occurs on mixing, and this is not the case with H_2SO_4 and H_2O. Thorpe is right.—WM. JOHN GREY, Elswick Science School.

[52430.] **Chemical** (U.Q.)—I do not think this can be done—at least, not by any reasonably practical method.—WM. JOHN GREY, Elswick Science School.

[52451.]—**Peculiarity in Vision.**—This must be due to some action of the muscles of the optical apparatus on the lens, but it would require a very careful examination to determine its exact nature. S. M. P.

[52453.] **C. R. Engines.**—Neither 76 nor 75 can now do the work they could previous to being altered. No. 114 is, perhaps, hardly so bad, but, even at their best, this class was never so good as 76 to 87 lot. As a rule, they do not steam as well as formerly, and the valves are injudiciously set for the class of work they have to do. Besides this, a great source of annoyance are the new injectors and throttle valves: the former do not lift the water properly, and the latter are not to be relied upon. The other engines so altered are 84, 116, and also, I believe, 113. With regard to the size of the cylinders, they run about 17in. I will now say a few words about the "renewals." These engines have been running the limited mails again, but assisted by an eight-footer. 420 class are scarcely ever out of the shops, as they are continually breaking down. It must have struck anyone how unsuited these engines are to the traffic: the 8-footer, with its soft, easy, regular beat, and one belonging to the 420 fraternity coming up behind her emitting a continuous roar. The 420 class, although rebuilt for passenger traffic, are still less suited for fast running than some other classes of 6-foot goods—viz., Nos. 190, 236, 288, and 161 classes, which have never been altered. The fact is, 420 class would give more satisfaction running goods trains. The new inside cylinder goods engines, built by Neilson and Co. (401 to 369), are giving great satisfaction, and I understand that twenty more of the same class have been recently ordered.—SAINT ROLLOX.

[52464.] **Boiler Templates.**—I think full information will be found in Nichols's book, which is sometimes advertised in these pages.—T. M.

[52465.] **Belt Working off Pulley.**—Seeing the difference of opinion that there is on the above subject, I will give a case which I had some time back, which I think will go far towards answering the question and settling the subject. We have a patent indiarubber and cotton belt (layers of rubber and cotton), 10in. broad. This belt is moved on and off the fast and loose pulleys three or four times a day when the engine is at full speed. The consequence is, that the edge of the belt nearest the fast pulley is worn very much more than the other edge, and when it has worn to a certain pitch it begins to travel towards the loose pulley, and do whatever we will we cannot prevent this turning it round regularly. Well, the first travelled towards the loose pulley there was for such was the tendency it had to travel to that side that the belt was thickest, that the friction made the strap-guide almost red hot. It also got against the upper room floor and set it on fire, which gave me and others no little trouble to put out. After this, I took the belt off and turned it round, when it travelled the contrary way: but a few throwings on and off soon got it all right again. I might say that the pulleys are well made, but very near flat. I think the above will prove beyond doubt that a belt will travel towards the tightest side, which is equivalent to travelling towards that part where the shafts are furthest apart or up-hill.—ENGINEER, Dewsbury.

[52477.]—**Sheep's Teeth.**—I think it is only tartar, or a scale caused by the action of acid on the enamel of the teeth.—FARMER.

[52487.]—**Telephone.**—"J. C." will find what he wants in many back numbers. For instance, Nos. 938, 939, 940.—T. M.

[52490.]—**Weight of Pump Valves.**—I think an answer to this query might be found in Mr. Davies's articles on Plumbing.—F. M.

[52491.]—**Legal.**—If you can prove that it was ordered, as you say, deliver it. If it is refused, summon for the value: but be sure that you have proof of the order, which should always be in writing.—LIME O' TH' LAW.

[52504.]—**Legal.**—You, as the leaseholder, must pay. For instance, A. had a house on lease, situated at the side of a country road, the garden being 300ft. long at back. By-and-by the freeholder let the land alongside and at the back, and a new street was made alongside A.'s house leading to a number of houses built at the back. The freeholder charged £5 a year each ground rent, which he put into his pocket, the land having previously been let at £2 an acre. Such, however, is the beautiful simplicity of the law, that while the freeholder made all that heap of money, without either toiling or spinning, the leaseholder A. had to pay for the paving, not only in front of his house, but also for the 300ft. alongside his garden which led to the new houses. He thinks that some reform is needed, though he says he would not mind if he were about to receive any benefit from the paving, which he did not want, or from the new houses erected at the back, which he would rather be without.—LIME O' TH' LAW.

[52518.] — **Water - Wheel.** — My thanks to "Moorman" and "R. J. L." (p. 393). I want the 70 h.p. for a slow steady motion. I cannot well state what it is until my model is complete, when, with the Editor's permission, I will give full particulars. Would a turbine give a *greater* h.p. than a "half-breaster" or "undershot," *the fall of* water being the same?—TINKER.

[52539.]—**Shutter for Photographic Lens.**—I have seen two excellent shutters, one working at the back of the lens, and one in front: the former, with a bellows which opens and shuts by pressing a small indiarubber ball, and allows the operator to give any desired exposure. The latter was shown me by Mr. Wiege, of Berners-street, and is a disc in front of the lens working with a spring and trigger, and will give an exposure as short as the 508th part of a minute. He showed me photos taken with it, two being exceptionally good: a hansom cab turning a sharp corner, and a bird pluming itself: one of the feathers, floating in the air, came out perfectly sharp.—BOSSI.

[52563.]—**Harmonium.**—I think "Fliegen" would do well to consider the reply given by G. Fryer to his previous query, for it is obvious that it is desirable only to convey to the windchest the wind obtained by the feeders. My feeders are each 18in. by 15, and I made ten 1in. holes over each of the wind trunks, and have since made the apertures in the valve-board to the sizes given by G. Fryer. I am unable to answer your query as to the escapement; but if you can obtain a copy of No. 109, Vol. V., I think you will find all the information on that point you can require.—PHONO.

[52563.]—**Harmonium.**—Five holes of 1½in. diameter give a total area of less than 9in., or, for the two wind trunks 17·6in. This is my difficulty. Leaving out the celeste valve, the area of the valves given on p. 248 amounts to 36in., so that when the two rows, 16ft. and 8ft., are being played, there is actually only half the area for the wind to come through from the bellows that there is for it to get to the reeds. I think the dimensions of the valves on p. 248 are too much, considerably. Perhaps Mr. Fryer will kindly say if he ever saw a harmonium with such large valves, and if so, how the escapements were fixed.—FLIEGEN.

[52577.] — **Organette.** — Much obliged to "A. S. L." and Mr. Fryer. Is it not sufficient for the latter that I am acquainted with, I think, all the published lists of music, not only for organettes, but for instruments that were worn out before organettes were born? I want to cut music for myself if possible—original music, and shall be obliged for the information how to set out the perforations. I will wait patiently for the promised instructions.—T. J. P.

[52583.]—**On Demand.**—To "C." — Thanks very much; but I have the notes already signed. I want to know how long they are good security, which I do not gather from your reply.—R. HANNEN.

[52607.] — **Soap.** — It would appear, from "Philo's" description of his plant, than he is in possession of a still without a permit from the Excise. As this involves a penalty, in addition to the costly waste of firing, it will perhaps be as well for him to disregard the statements of those who decry cement--i.e., non-conducting coverings. For the boiler, use one of those advertised in this paper; for the pipes, if under cover, a good lapping of straw bands will be the cheapest; and for the soap-pan, 4½in. brickwork, if it can be arranged. It is possible, however, that in addition to the condensation going on, his boiler, being a small one, primes; and if he cannot avoid this by careful firing, he should have a strong iron box placed near pan, with a steam trap at the bottom; by fitting his steam main to it (the box) he would get rid of both condensed and priming water; but if he is making pale soap only, and not curd mottled, he can open out at the end of the "change in strength" with a bit or two of caustic soda. There is, however, such a remarkable amount of amateur's ignorance (no offence meant) about the queries that have appeared of late *re* soap and its manufacture, that I hardly know how to advise. However, if "Philo" is in the vicinity of a large works he will find a small soapery about as ready a means of dropping money as is at all necessary in this age, when it is not so easily picked up as in the good old times; in truth, I think no business has been so close-run in the matter of profit as the soap trade—not a mere temporary depression, but chronic, without the slightest chance of a turn, and this not only at home, but in the colonies also. So if those who require advice will give some slight indication of the locality their works are in, the county or country (if abroad), I will have pleasure in giving any information I possess. After this long preamble we will return to business. Modern soaperies are fitted up without any exterior-fired pans; and a proper coil or jacket will boil any amount of soap, if proportionate to the size of pan. Inasmuch as the head is boiled out and in of curd mottled by no other means in one of the largest London soaperies, "Philo" may depend upon it that his failure in the use of a coil must arise from small size and weak steam. As for not being able to melt tallow with one, why, surely, he must mean render. Why, even stearine does not require any great heat for its liquefaction; and what chance modern, high-pressure grown, greasy tallow can have against even 5lb. steam I cannot understand. If, however, he really means the rendering down of butcher's fat, his failure is natural enough. Now, if "Philo" will cover his boiler and steam pipes, and use steam at, say, 20lb. pressure, he will not find any need for a dry coil in the making of pale or other close soaps. Of course, his strong leys are not less than 16 per cent. Twaddell cold, if made at his works. If he uses caustic he can go as high as 20 per cent.; but the soap is no better for the excessive graining some boilers give it. How is he going to get strength into soap when it has been curded into peas almost? So long as he gets a fair break in it he can depend upon getting all his excess of strength away, and a much greater amount of dirt and colour in his leys than will come away if he boils his soap hard. The mottling of curd mottle is proof enough of this assertion, as the mottle is only dirt held up by the stiffness of the curd. Have had numerous interruptions during the scribbling of this, and any point overlooked shall have full attention if full details are given with query.—LONDON STONE.

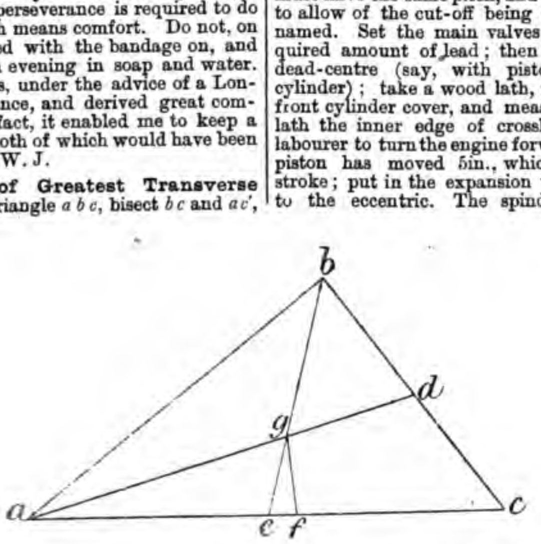
[52620.] — **Pyrotechny.**—"Pyrotechny; or a Familiar System of Recreative Fireworks," by G. W. Mortimer. published by J. S. Hodson, 22, Portugal-street, Lincoln's-Inn; and "The Art of Pyrotechny," price 2s. 6d., published at the *Bazaar* office, 32, Wellington-street, Strand.—R. A. R. BENNETT.

[52632.]—**Gas Fires.**—I have had experience as user of these for some years. Asbestos and pumice stone both smell, besides being, I suspect, unhealthy, as liable to condense noxious gases. Fireclay "fuel" and a single fireclay burner is, I consider, far superior. giving absolutely no smell, besides a far brighter fire. The chimney must, of course, be open.—SATISFIED AT LAST.

[52642.]—**Copper Deposition.**—Iron articles, destined to receive an adherent coat of copper, should be first immersed and soaked in a pickle composed of sulphuric acid and water equal parts, to which has been added of muriatic and nitric acids one-twentieth each of the bulk of sulphuric acid employed. When all rust and dirt have been removed in this pickle, well scour the surface of the iron in sand and water, pick out all sand from holes and crevices with a sharp wire, then rinse well in clean water, and hang at once in an alkaline solution of copper, exposed to the strong current from a dynamo-electric machine until a complete film of copper has been deposited on the article. Then remove it from the alkaline bath to the ordinary electrotyping solution, and put on as thick a coat as may be desired in this solution. Be sure to rinse the articles well whilst transferring them from one solution to another, and lose no time in the process. A useful alkaline solution of copper, to be worked cold, can be made by adding ammonia carbonate, or liquor ammoniæ, to a solution of copper sulphate until the green precipitate, first formed, is all dissolved, and a clear, bright blue liquid appears; then add cyanide of potassium solution to this until all the blue tint disappears, when the solution will have the appearance of old ale. This should stand exposed to the air for a few days to get rid of excess of ammonia before working the solution.—GALVANOPLAST.

[52649.]—**Varicose Vein.**—"H." says, "Much more effectual than ordinary surgical bandage, and much cheaper than ordinary elastic stocking, is Esmarch's bandage, a surgical elastic bandage." Its use is thus described in "Druit's Surgery," p. 774, of the 11th edition:—"It is especially useful in amputations, excisions, and operations on bone. By completely emptying the veins as well as the arteries and capillaries, of blood . . ." If a "Poor Sufferer" asks for, and gets the thing, he won't be troubled with varicose veins very long, nor with a leg either, for that matter. Supposing he uses it, gangrene would set in and the leg rot off. What the correspondent means is a Martin's pure rubber bandage. The best width is about 2½in., and about 3 yards long. They can be had for about 4s. 6d., of any respectable chemist and druggist. There are other makes, perhaps, nearly as good; but a pure rubber bandage is what is wanted. They have been found of immense service in tiresome cases of chronic eczema, as well as for varicose veins. A caution as to their use and mode of application:—Put the bandage on before putting the foot to the ground in the morning. Begin to wind on carefully, holding the rolled-up bandage well in hand, and not letting out more than three or four inches at a time. Let the pressure be just comfortable, and no more. Persuade a surgeon to show how to apply it, if one will kindly do so. In any case, a deal of practice and perseverance is required to do the job neatly; which means comfort. Do not, on any account, go to bed with the bandage on, and wash it carefully each evening in soap and water. I wore one for months, under the advice of a London surgeon of eminence, and derived great comfort from its use; in fact, it enabled me to keep a situation and a leg—both of which would have been *minus* but for it.—R. W. J.

[52654.] — **Point of Greatest Transverse Strain.**—Draw the triangle *a b c*, bisect *b c* and *a c'*, draw the lines *a d* and *b c*, the intersection at *g* is the centre of gravity. Erect perpendicular *g f*, measure the distance $fc = 45 \frac{4\cdot5 \times 10}{10} = 4\cdot5$ tons at *a*, 10 tons 4·5 = 5·5 at *c*, the point of greatest strain.—PALMER, Accrington.



[52653.]—**Electric Current.**—"Antares," p. 435, has not got the matter quite right. He still seems to fancy there is some difference in the currents themselves. This is not so; the difference is due to other elements, and real comprehension requires us to keep each idea distinct. "Density of a current," to which I referred, is not a property of the current, but of the conductor in which it passes. I will give the most striking illustration I know of. Take a foot of stout iron wire and file it away in two long cones, till it is a thin wire in the middle. Now pass a current. This is exactly alike and equal at all parts, yet the middle of the wire will be raised by it to a white heat, while the ends are cool. This is not due to any difference in the current, but to the greater rapidity of the molecular motions involved, because effected in fewer molecules. Current is simply the number of such motions at each instant in each section of the conductor. Now for so-called "tension of the current." Take a wire of 1 ohm resistance, place it in a circuit of a large single cell, setting up 1 ampère of current. The difference of potentials between the two ends of the wire is 1 volt. The difference of potential between the middle of the wire and the – pole of the battery will be about 1 volt. Now place this same wire in the circuit of, say, 2,000 cells, close to the + pole of the battery, and with such resistances besides as will send 1 ampére current through. We have here the same current as before in all respects, and there will be the same fall of potential of 1 volt between the ends of our wire. But between its middle and the – pole of the source there may be 2 or 3,000 volts difference of potential, and it would be dangerous to touch. But this, again, is due to no difference in the current, *as current*, but to the sum of all the forces and resistances in the whole circuit; in fact, to a set of considerations with which the idea and the measurement of current have nothing to do. We are more likely to add to the number of units than decrease them; in fact, I see to-day that Sir W. Thomson has just proposed one, "mho."—SIGMA.

[52658.]—**Expansion Valve.**—This term has such a wide meaning, and includes such different varieties of valves, that it would, perhaps, have been better if the querist had stated definitely what kind of expansion valve he wishes to have information on. However, let us suppose that the query refers to what is generally called the back slide expansion or cut-off valve, which is in more general use than any other. The kind we will now consider has right and left-hand screws on the expansion valve spindle, for the purpose of adjusting the valves to cut off at any desired point, which may be done either by a hand-wheel, or coupled through a train of gear wheels with the governor. Another form of automatic expansion valve is controlled by the governor raising or lowering a slot link, and so shortening or lengthening the travel of the valve. Both the above arrangements dispense with a throttle-valve. In another form of valve the expansion is not made adjustable without altering the position or throw of the eccentric. We will not consider this kind of expansion arrangement. Our supposed engine is of the horizontal type, 5ft. stroke of piston, with slide-valves at each end of cylinder, and the cut-off adjustable from, say, one-twelve stroke to ¾ stroke. The screws on expansion valve spindle, though made to different diameters, must have the same pitch, and be made long enough to allow of the cut-off being altered to the extent named. Set the main valves first, giving the required amount of lead; then put the crank on dead-centre (say, with piston at back end of cylinder); take a wood lath, put one end against front cylinder cover, and measure or mark on the lath the inner edge of crosshead. Now get the labourer to turn the engine forward slowly, until the piston has moved 5in., which is one-twelfth of stroke; put in the expansion valves and couple up to the eccentric. The spindle should now be moved round until both the expansion valves are at equal distances from the ends of the screws on valve spindle, leaving, say, two or three threads to spare. Now move the excentric forward until the back expansion valve covers the steam port in the main valve. Secure the excentric temporarily, and move the engine round to the other centre, and repeat the process at that end. As a general rule, you will find the expansion excentric to be from 130° to 160° in advance of the main valve excentric. Now, having set the expansion valves for one-twelfth cut-off, if the screws have been correctly cut on the expansion valve spindle, turn the hand-wheel on the outer end of same spindle until the index points to any other later cut-off, and test again, and you ought to find all correct for that point of cut-off. If you have never seen expansion valves set, you may have a little difficulty at first; but it will come all right by-and-by. The advantages of expansion valves in an engine are very great. To state it shortly, they enable an engine to use up the steam to the greatest advantage; and if an engine with a given pressure of steam in the boiler can do a certain amount of work, any variation of that pressure can be easily compensated by a suitable alteration of the cut-off, instead of throttling or "wire-drawing" the steam. There are other advantages, too, which a little experience with the expansion valves will show you—all of them, however, valuable. If I have not explained the class of expansion valves with which you are acquainted, state what class they are, and I will do my best [illegible] you. LABOR OMNIA VINCIT.

[52650.] **Soft Spelter.** [illegible] kindly make that mixture [illegible] p. 431, and let us know the result? [illegible] the recipe out of a book, [illegible] once, and put less faith in the other recipes [illegible] [illegible]

[52650.] **Soft Spelter.**—If Mr. Hale has never tried the recipe that has taken up valuable space, he had better do so at once, and I [illegible] think he will be the first one. [illegible] that it would be a good way of brazing [illegible] be done, but can it? That's the rub. We live and learn. I did not know that [illegible] would make a workable alloy. I should be sorry to mix an ounce of silver with an [illegible], especially if money was short.—VOLT.

[52650.] **Soft Spelter.**—Last week a recipe was given for cold brazing of iron, consisting of "fluoric acid, steel filings, and brass filings placed in an earthenware jar." Now, as all chemists know, the fluoric acid would immediately attack the silicon of the pottery, and the mixture when prepared would do nothing, except produce ulcers on the hands of the one who is soft enough to prepare it. This hoaxing recipe, which appears in "Workshop Receipts," has been exposed several times in "ours," and I really think it is time that it should be tabooed altogether.—S. BOTTONE.

[52659.]—**Brazing without Heat.**—The old, old story of brazing cold, with fluoric acid, &c., &c., is once again "stumping the press," resuscitated after its death and burial, this time by John Hale, Univ. Coll., London. If he has ever used his own recipe, or has ever in his life seen any brazing done with the assistance of fluoric acid, &c., in an *earthenware* jar, will he send a sample, or sufficient proof of the fact, to the Editor? If this sample is on view at the office of the MECHANIC, I will pay John Hale, Univ. Coll., London, £5 for his trouble in sending it. The exhibition of the sample will be as good an advertisement to the MECHANIC as the presentation of a seven-roomed house has been to another paper recently. It is to be hoped, until someone has performed this feat so highly spoken of, that any further communications on the subject shall be added to the waste-paper basket. Once more will pennyworths of fluoric acid be in demand at the druggists' shops, many times more will the British workman make his fingers sore and use bad language, and once more shall we have numerous correspondents saying they have tried and failed. N.B.—When I was young and foolish, twenty five or thirty years ago, *I* tried, and failed, but omitted the bad language usually expended on this process.—THOS. FLETCHER.

[illegible]—**Cleaning Gaiters.**—Try a weak solution of ammonia and water before washing.—[illegible]

[illegible]—**Bartolozzi.**—The exhibition was held at the Savile Gallery, [illegible], Savile-row, Burlington-gardens, W., and was closed about June. It is now reopened as the Windsor Gallery School of Fine Painting. The exhibition was conducted by Mr. [illegible] Nash, who now carries on the [illegible] "X. Y. Z." to make application to him for the return of the picture.—[illegible]

[illegible]—**Dampproof Glue.**—Will "Archi[illegible]" [illegible] the method of preparing [illegible] readers?—[illegible]

[illegible]—**Cement for Pavement Lights.**—It [illegible]—[illegible]

[illegible]—**Bottle Batteries.**—[illegible]

[illegible]

[illegible]—**Zoned Chimneys.**—The chimneys [illegible] would be safe [illegible] small height, say [illegible] ft. [illegible] chimneys to [illegible] without extraneous support [illegible] that the extreme height above the [illegible] be not more than six times the [illegible] at the base.—[illegible]

[illegible]—**Steam Launch.**—I think "W. W. H." will [illegible] miles an hour out of [illegible] I think [illegible] information about all [illegible]—[illegible]

[illegible]—**Steam Launch.**—[illegible] at the rate of about eight [illegible] long [illegible] any speed approaching [illegible] the Thames it might be possible [illegible] from six to eight, but not more. If [illegible] he will find much [illegible] in Vols. XXXII. and XXXIII. [illegible] that a boat [illegible] and boiler big enough to drive it at 14 miles an hour.—[illegible]

[illegible]—**Chimney.**—I should advise "P. H." to consult a competent architect as to his proposed chimney. The Bradford accident was the result of amateur design and superintendence.—[illegible]

[illegible]—**Chimney.**—If "P. H." applied to the Secretary of Civil and Mechanical Engineers Society, 1, Westminster Chambers, most likely he could peruse the manuscript of a paper read before the society, which would give him all he would require in constructing his shaft.—T. BROCKLEBANK.

[illegible]—**Chimney.**—I do not know of any articles having appeared in these pages on chimneys. There were a few queries and answers a few months ago. The best and only good work I know on chimneys is "Boiler and Factory Chimneys," by R. Wilson, C.E., published by Crosby Lockwood and Co., [illegible]. Molesworth gives a few lines also.—BOSWELL.

[52726.]—**Fishing Flies.**—The back and neck feathers of the golden plover are used to make "the golden plover hackle"—a good summer fly for trout. Thick shellac varnish is the best for making the heads of flies—merely shellac dissolved in spirits of wine.—FAL.

[52727.]—**Quantity of Water Used per Hour.**—The following rules are from Molesworth's Pocket Book:—Multiply the pressure per square inch by 2·307, which will give the head of water in feet. The velocity per second must next be found by the following rule: $8·025\sqrt{\text{Head}}$. To find the quantity, multiply the area of the aperture in sq. ft. by the velocity per hour, the result will be the number of cubic feet used per hour, which, multiplied by 6·24, will give the quantity in gallons per hour.—ROWLAND GASCOYNE, Conisbro, Rotherham.

[52731.]—**Axle of Plate Machine.**—Why would not metal do? as "H. H." himself asks. Nine out of ten are made of metal, with a fixed and a screw flange to grip the glass. Glass would be useless, as it would snap; and ebonite would not wear at the bearings unless cased in metal. Vulcanised fibre would be stronger than ebonite.—SIGMA.

[52731.]—**Axle of Electrical Plate Machine.**—What makes you think a metal axis won't do? You are mistaken, anyhow. A brass rod answers best, fitted with a fixed cap at one side of the plate, and a screw to enable the other cap to be screwed tight on the other side. Two pieces of thick cloth are placed between the caps and the glass plate, one on each side, to prevent smashing the glass by too much pressure. For the same reason the movable cap must not be screwed on too tight.—R. A. R. BENNETT.

[illegible]—**Axle of Electrical Plate Machine.**—The axle is usually constructed of metal. Three-quarters of an inch is ample diameter. Two metal cheeks, one of which can be screwed down against the glass plate, is the usual way of fastening the plate to the axle. A little warm electrical cement [illegible] just before screwing up. The metal [illegible] may be cased in an ebonite tube if desired; but the [illegible] difference is very slight. Such a [illegible] without rings, will give a [illegible] spark; [illegible] diameter, 4 to [illegible] spark.—[illegible]

[illegible]—**Permanganate Stain on Carpet.**—[illegible] sulphide [illegible] the carpet might be [illegible] most harmless [illegible] which [illegible] permanganate [illegible]

[illegible]—**Finding Speed of Trains.**—[illegible]

that the diameter of the driving wheel is [illegible]. For instance, an engine has a driving wheel the diameter of which is 8ft., the circumference is [illegible] times the diameter, therefore the circumference is equal to $\frac{176}{7}$ft., the distance which the engine will travel in one revolution of the driving wheel; in 12 puffs it will have travelled [illegible]; say, for example, that it travels $\frac{176}{7}$ft. per second, that is approximately 25 yards per second, then the speed of engine is equal to 50 miles per hour.—SIGNAL BOX.

[52733.]—**Finding Speed of Train.**—[illegible] Webb's compound engines have one low-pressure cylinder, consequently, there are but two [illegible] puffs for each turn of the wheel. To estimate the speed of a train from the "puffs" of steam would indeed be an incorrect method. In the first place, at high speed, they would be difficult to count; [illegible] better take the number of times a connecting rod comes to a certain position. To find the revolutions a wheel will make per mile divide 1,680 by the diameter of the wheel; thus $\frac{1680}{8} = 210$, showing that an 8ft. wheel revolves 210 times per mile, and, of course, the same number per minute when the train is running at a speed of 60 miles an hour.—HISTORIAN, M.I.M.E.

[52733.]—**Finding Speed of Train.**—"C. R. R." will find it rather close work, [illegible] beats of a locomotive accurately, when they are as frequent as 11 or 12 a second. However, a little calculation shows he has been nearly right—that is, of course, supposing the wheels do not slip. Thus the 8ft. wheel will be 25⅛ft. in circumference. Multiplied by 11, gives 276⅜ft.; divide this by 4, number of beats to a revolution, gives feet per second as 69 and a fraction. As 88ft. per second equal 60 miles per hour, 69ft. in the same time would be 47 miles per hour, as near as may be. Is "C. R. K." quite sure he is not enjoying a quiet smile at our expense? While on this question of speed, perhaps the following table may be of interest, as showing what man has done in the way of obtaining celerity of transit by mechanical means in the locomotive engine, in comparison with the rapid motion of the air, the progressive power of his friend the horse, and his own poor, feeble, unaided efforts in walking:—

Miles per Hour.		Feet per Second.
60	Speed of wind in hurricane, and of very fast express trains ..	88
50	Hurricane........................	73⅓
45	Running time of express trains	66
40	Tempest	58⅔
35	....	51⅓
30	....	44
25	....	36⅔
20	Horse's gallop; brisk gale	29⅓
15	Gale; fast trotting horse......	22
10	Speed of a good trotting horse..	14⅔
7½	....	11
5	Gentle, pleasant wind; fast walking........................	7⅓
*4	Ordinary walking	5$\frac{13}{15}$
*3	Slow walking	4⅖
2	....	2$\frac{14}{15}$
1	Wind hardly perceptible	1$\frac{7}{15}$

* It has been stated as the result of careful experiments, that the least exhausting and best pace for adult males is 3½ miles per hour.

—R. W. J.

[52734.]—**Paper Tubes.**—Cut strips of ordinary cartridge paper, the same width in inches you want the tubes to be long, and about a yard in length; cover them evenly with strong paste containing glue, and then wind tightly round cylinders of wood turned to the required length and diameter of inside of tube, taking care to leave the first fold or lap without paste, so as not to adhere to the smooth roller. Let get quite dry, and then extract cylinder by tapping one end with a hammer.—JOHN HALE, Univ. Coll., London.

[52735.]—**Coloured Pencils.**—The colouring matter consists of mineral red chalk in the one case, cut into slips with a saw, and in the other of soluble Prussian blue with whiting.—JOHN HALE, Univ. Coll., London.

[52737.]—**Steam Boiler.**—Your query is very vaguely worded. Give dimensions of a boiler, class of work you want it to do, and pressure you wish it to carry: I will then answer you fully. Plain egg-ended boilers are great fuel wasters, compared with the Cornish and Lancashire types.—J. F. W.

[illegible]—**Steam Boiler.**—The egg-ended boilers are certainly the safest and most durable when everything is taken into consideration. Even in so small a boiler as 3ft. diam. it ought to be either strengthened by stays or ribs; but we must not forget that a boiler with flat ends made extra strong is liable to bulge out, under internal pressure, at the centre—that is, to assume a barrel shape. Those who have given considerable attention to this subject state that the flat ends of tubular boilers ought to be in one piece, either solid or [illegible].—ROWLAND GASCOYNE, Conisbro, Rotherham.

[52737.]—**Steam Boiler.**—Is "Steam" speaking about toys or boilers? or is he laying a trap to let someone (or perhaps himself) fall into? Toy boilers are seldom made egg-ended, while working boilers often are. Toy boilers are often made flat-ended without stays, while working boilers are most frequently made with flat ends efficiently stayed. In speaking of a square end, I presume "Steam" means flat end; but the safety of a boiler depends on other points as well as form of ends, as the form of end affects end safety only. I may inform "Steam" that a flat unstayed end of given area and thickness is much weaker than an egg-shaped end of equal thickness and area, consequently flat ends are never put in without staying them, except in very small boilers or toys. Egg-shaped ends are rarely stayed; but to fully explain this query would require more space than our editor would be willing to give on a query which would only interest a few; but if "Steam" will put such queries in a clearer form I will give him the benefit of my experience.—BOSWELL.

[52738.]—**To Fasten Fan Blades and Arms on Spindle.**—"Sandy Sam" must have a boss cast, with arms on, in gunmetal. Put a print on pattern, or bore hole through casting to fit spindle, and secure with a set screw. Two arms will be enough. If for a fan, make the fans out of thin iron, and turn up at the sides to catch the air.—VOLT.

[52739.]—**Electric Bell.**—Several forms of door contacts are made which will ring the bell whilst the door is being opened only. They are fixed upon the frame above the door in such a position that the top of the door touches the drop-piece as it passes. The length of time the bell is wanted to ring can be regulated by the distance at which the drop is fixed from the joint of the door. If at 6in., the bell rings when the door is opened 2in., and stops when open 2ft. If you want a good battery without porous cell, use the original form of Leclanché's agglomerated battery.—R. T. LEWIS.

[52740.]—**Drying Damp Room.**—The simplest way to dry the room is to put a flue in, so that a current of air can be got through it. The only other way is to place a large tray containing dry chloride of calcium in the room, and as this takes up water and becomes fluid, to evaporate it to dryness again over a fire or powerful gas-burner. This will be a great deal of trouble, and not so effectual as a good flue.—THOS. FLETCHER.

[52743.]—**Lathe Saddle.**—The information "Q." desires is already in MS., forming a portion of the eighth and supplementary chapter on "How to Make a Cheap Lathe," and will shortly be in type. I think that he will find it contains all necessary instruction; but if not exactly the thing required please say so, and I will write again.—J. H.

[52744.]—**Marble.**—Let me recommend the following to Mr. E. Beaumont:—(1) Take 2 parts soda, 1 of pumicestone, and one of finely-powdered chalk, sift these through a fine sieve, and mix them into a paste with water. Rub this well all over the marble, and probably the stains will be removed; then wash it with soap and water, and a beautiful bright polish will be produced. If this does no good try the following:—(2) Clean with diluted muriatic acid, or warm soap and vinegar; afterwards heat a gallon of water in which dissolve 1½lb. of potash, add 1lb. of virgin wax, boiling the whole for half an hour, then allow it to cool, when the wax will float on the surface. Put the wax into a mortar and triturate it with a marble pestle, adding soft water to it until it forms a soft paste, which, laid on the marble and rubbed when dry with a woollen rag, gives a good polish.—JOHN HALE, Univ. Coll., London.

[52745.]—**Furnace.**—My opinion is that your work can be done in an ordinary fire with the bellows. I think the fault is with you, by forcing your fire too quick, thereby burning the outside before the inside is at a welding heat. I have welded 4in. square bars in an ordinary fire with ordinary 36.n. bellows worked by hand. I have tried the fan-blower, but since have had 24in. double blast bellows, which I think is the best thing for good work: they are noiseless and easy to work. Should be able to do it with coal, but certainly fire would be clearer by using breeze.—ALBERT HALL, Weston, near Honiton.

[52746 and 52750.]—"**Edco**" **Battery**.—Each box of "Edco" battery will give 4 volts and 5 ampères steadily for 90 hours; this would only give sufficient energy for lamps of about 1½ candle-power. With 3 "Edco" boxes, 3 lamps of 5 candle-power can be lighted 126 hours at a total expense, including zinc consumed, of 7s. 6d., or 1 farthing per lamp per hour. Lead lining is used in preference to glass, vulcanite, or earthenware, from its non-liabilty to crack from heat or rough usage. There is, of course, no necessity to insulate the carbon plates from the lead, as they would even in that case be joined by their proper connections, as well as by the liquid.—C. R. H.

[52751.]—**Recovering Silver.**—The best way would be to dissolve the bits of iron in nitric acid, which would dissolve silver and all; the silver could then be precipitated by mixing this solution with hydrochloric acid till no more ppt. is formed. The ppt. is then washed to get rid of nitrate of iron. When dry, mix it with twice its weight of carbonate of soda, one-tenth of its weight of potassium nitrate, and a little borax to act as a flux. This mixture is to be put little by little into a red-hot crucible, and heated red-hot for about a quarter of an hour, stirring it occasionally; after which the contents of the crucible are poured out on a piece of slate. The silver will be found to have collected at the bottom of the crucible, and must be freed from soda carbonate, &c., by breaking it off with a hammer and washing with hot water. This is not very much trouble, I think, and all the silver would be saved this way if the operation is carefully performed. I recommend this to the notice of chemists who don't know it already, as if all the precipitates made by silver nitrate are treated in this way, the same amount of silver can be made to last almost *ad infinitum*, which, as it is an expensive substance, is quite worth doing.—R. A. R. BENNETT.

[52752.]—**Clock to Strike by Electricity.**—The first part of this question was answered (with a diagram) on page 372 of present volume. The wires would, of course, have to be longer if the clock was in another part of the house; but this would make no difference to the arrangement.—R. A. R. BENNETT.

[52752.]—**Clock to Strike by Electricity.**—Several answers have been given lately to this question. The simplest plan is to arrange a contact actuated by the lifting of the hammer of the clock; either let the hammer itself be in circuit and close it by merely touching a light spring, or arrange two springs insulated from each other, and placed close to the hammer, so that as it rises it brings them together. It would be waste of time and money to try to regulate existing clocks from a central one, seeing that it would be cheaper to make new ones, with a mere system of hands and their gearing, driven altogether from the clock.—SIGMA.

[52757.]—**Silvering Solution.**—Potassium cyanide argento, or, as Mr. J. Hales remarks, otherwise silver solution, will leave a deposit of silver on base metal such as brass and copper, and it is done in this way: Take ¼lb. of cyanide of potassium, and ½oz. of nitrate of silver; dissolve all the cyanide in 16oz. of distilled or boiled water, and the silver in a similar quantity in another vessel. Into the vessel containing the silver throw a spoonful of common salt; stir this up well with a clean piece of wood, and let it settle; dissolve some salt in water, and after the silver solution is settled mix a few drops of the salt water in it. If there is any cloudiness formed, it proves that all the silver is not thrown down, and more salt must be added, and then stir and allow to settle. If the addition of salt water has no effect, the water may be decanted off, carefully preserving the white deposit. Now pour some boiling water on this deposit, let it settle, and pour off as before. Do this at least three times, pour off as dry as possible, and add a pint of clean boiled water, and then, by ¼oz. at a time, the cyanide solution, till all the white precipitate is dissolved; add enough water to make half a gallon; stir well after each addition of cyanide solution. If on dipping the article, which must be well cleaned with brickdust and water, into this solution, the silver deposits on immediately in a dark powder, it must be weakened by adding more water; if it coats too slowly, more white precipitate must be prepared, washed, and added to it. This must also be done when the solution is getting short of silver. It works best at about 60° or 70° Fahr., and a dry warm room helps the operation. This method gives a most beautiful result when the work is polished and burnished.—JOHN HALE, Univ. Coll., London.

[52760.]—**Safety Valves.**—You will find the following rule easy and accurate. When load and pressure are given we have for length of lever—

$$L = \left\{ \left(P \times A \right) - \left(V + \frac{w \times g}{l} \right) \right\} \frac{l}{W}.$$

Where—

L = distance between weight and fulcrum.
P = pressure in lb. per square inch above atmosphere.
A = area of valve.
V = weight of valve.
w = weight of lever.
g = distance of centre of gravity of lever from fulcrum.
l = distance between valve centre and fulcrum.
W = weight of ball.

—J. F. W.

[52760.]—**Safety Valves.**—This query is very indefinite. A safety-valve can be had in a hundred different forms, each of which would require a different mode of calculation. Supposing the valve to be of the ordinary lever construction, the working out would be as follows:—A = total pressure of steam on under side of valve; L = length of lever; F = fulcrum of lever; and W = weight of ball hung on lever. W and A are in pounds, F and L in inches. (1) $\frac{L \times W}{F} = A$, and (2) $\frac{W \times L}{A} = F$, and (3) $\frac{F \times A}{W} = L$, (4) $\frac{F \times A}{L} = W$; so that from the foregoing formulas, any of the four items can be found. This does not take into consideration (which I consider to be balanced) the lever and valve. If "Phonographer" will give details of his valve, I will give it my attention; or advertise his address, and I will correspond. The proportion of valve area should be about ¾ square inch to each square foot of firegrate.—BOSWELL.

[52760.]—**Safety Valves.**—It is necessary, first, to ascertain the pressure caused by the weight of the lever alone. This may be done by the following method, if the valve is an ordinary lever safety valve:—Multiply the weight of the lever by half the leverage, and divide by area of valve. The product is the pressure per square inch. Subtract this from the intended blowing-off pressure, and the remainder will be the pressure that must be provided for by ball weight; hence, multiply this by area of valve, and divide by the weight of the ball. The product will be the leverage required, which multiplied by distance from fulcrum to valve spindle gives the distance from fulcrum to ball.—ENGINEER, Dewsbury.

[52760.]—**Safety Valves.**—The rule for adjusting the safety valve of a boiler is as follows:—Let W = weight at end of lever, L distance between weight and fulcrum, w weight of lever, g distance of centre of gravity of lever from fulcrum, P = pressure of pounds per square inch above atmosphere, V = weight of valve, A = area of valve, and l distance between valve centre and fulcrum, then—

$$P = \left\{ \frac{(w \times g) + (L \times W)}{l} + V \right\} \div A$$

$$W = \left\{ (P \times A) - \left(V + \frac{w \times g}{l} \right) \right\} \frac{l}{L}$$

$$L = \left\{ (P \times A) - \left(V + \frac{w \times g}{l} \right) \right\} \frac{l}{W}$$

When the lever is prolonged beyond the fulcrum, and provided with an adjustable weight, the following simple rules may be used—

$$P = \frac{WL}{Al},\ W = \frac{PAl}{L},\ L = \frac{PAl}{W}.$$

Trusting the above will be useful to "Phonographer" and others.—ROWLAND GASCOYNE, Conisbro, Rotherham.

[52762.]—**Hens Losing Feathers.**—A roosting-place too small, if shut up close, would be too warm and suffocating unless well ventilated at top, and if dirty, would be most unhealthy and full of vermin, causing loss of feathers. But a small roosting-place is better than a large one, if it be whitewashed with hot lime occasionally, cleaned out with a trowel every morning, and dry ashes or earth spread on floor. Perches may be only 6in. high; ventilation at top is essential. If your hens have vermin, let them have plenty of dry ashes with flowers of sulphur mixed through. Your two meals of Indian meal twice a day is too much if the fowls have plenty of field space. One meal at evening of oats, barley, or small wheat, &c., should be enough. See that they have fresh water every morning, and lime or plaster to pick at; also a small shelter from rain, and keep no fowl exceeding 19 months in age, or any hatched after April.—W. DODD BECKETT, Dublin.

[52764.]—**M'Naughted Engines.**—M'Naught was an engineer who pieced out the power of the old mill beam engines, providing a higher pressure of steam and a cylinder to work it in before entering the old cylinder at the old pressure; consequently, a beam engine which has been compounded is called a M'Naughted engine. Stamper valves are opened and closed almost instantaneously, whereas the slide-valve movement is much more gradual by the eccentric motion.—J. F. W.

[52764.]—**M'Naughted Engines.**—Are beam condensing engines, to which a non-condensing cylinder has been added, generally at about half distance between beam centres and the crank? The engine then is a compound. This plan is often carried out when the engine becomes too small for the work required; but occasionally new engines are made on the same plan. A stamper valve is a double-seated equilibrium drop valve. Cornish valves are sometimes miscalled stamper valves.—LABOR OMNIA VINCIT.

[52765.]—**Prevention of Electric Sparks.**—Wind outside the magnet-coils another circuit of high resistance, with its ends soldered to those of the magnet wire, as a shunt. Instead of a spark on breaking contact, there will be a current in this wire.—SIGMA.

[illegible]—**Prevention against Sparking in Electrical Contact Breakers.**—There must be something wrong with the platinum, surely. The use of platinum for contacts is to prevent this very occurrence, if I am not very much mistaken. It has never happened to my apparatus. If "Sigma" answers this question, I expect Mr. Sprague will [illegible].—R. A. R. BENNETT.

[illegible]—**Magic-Lanterns.**—Oil lanterns can be worked one above the other by using a bent chimney for the lower one; but I think there is no advantage in so arranging them, and that the old plan of using the lanterns side by side is more convenient. For registering effects the slide carrier introduced by Mr. Chadwick, of Manchester, is excellent if the slides are unframed; but if framed, the only way is to register them by trial on the screen. and make such marks, use stops, packings, &c., as may be found necessary, either on the slide frame or lantern fronts. This necessitates a great amount of care, and a considerable expenditure of time if anything like a good result is desired, and thorough rehearsing is necessary before giving an entertainment. I am told that Mr. Malden takes all the summer to register the effects for his winter exhibitions.—DITTON.

[52769.]—**Dynamo.**—To S. BOTTONE.—If made twice the size. and driven at 3,000 revolutions per minute, it will light well six 10-candle Swan's lamps. Every part should be double the size except the wire, and that might be 7lb. of No. 18 on each leg of the field magnets, and about 1lb. do. on the armature. But this form of machine does not do for continuous work: it gets too hot. (See also 52776).—S. BOTTONE.

[52770.] — **Grandfather's Clock.** — If "D. W. W." examines the fly, he will probably find the holes very much worn, so that fly train does not start off. Or possibly fly pinion is much cut as well. If so, put fresh holes, and shift wheels below to run on another part of pinion. Large holes, however, will alone account for it.—A. E. B.

[52772.]—**Tinning Bright Steel Goods.**—The tinned surface is rendered bright by friction. The bath may be retained at the proper strength by small additions of fused protochloride of tin.—JOHN HALE, Univ. Coll., London.

[52773.]—**Waterwheel.**—The amount of water that the 5in. double-acting pump would deliver would be useless unless you could get a very high fall; and if you had to force it up a suitable elevation, the power given out would not repay the cost of pumping it up.—LABOR OMNIA VINCIT.

[52774.] —**Strabismus.**—I have not said that electricity is applied to the muscle of the eye. What I said was that if electricity is applied it should be only under skilled advice. If the spectacles are of no use, a simple surgical operation, which I suppose is scarcely felt, effects a cure.—S. M P.

[52775.]—**Dynamo.**—To S. BOTTONE.—If made half as large again, and wound with 5lb. No. 16 on the magnets, and ½lb. of 18 or 20 on the armature, you would be able to light four 10-candle Swan lamps on the lathe: but you must so arrange the rigger and driving wheel as to get at least 3,000 revolutions per minute. But you will find it hard work, and such a dynamo cannot be run for more than 20 minutes without getting dangerously hot. —S. BOTTONE.

[52776.]—**Dynamo.**—By a printer's error (I presume) my query says "three or four hours daily equal to 10 c. p. Swan incandescent lamps:" I meant to say "fifty 10 c. p. Swan, &c."—JOHN HALE, Univ. Coll. London.

[52776.]—**Dynamo.**—If you will take my advice you will construct a machine on Heinrich's principle. It is fully illustrated in Vol. XXXIII. p. 28. If you will kindly state how many 10-candle lamps you require to use, I will give you the information required as to horse-power required, and size of dynamo, wire, &c.—S. BOTTONE.

[52778.]—**Dissolving Views.**—See answer to 52766.—DITTON.

[52778.]—**Dissolving Views.—Registration of Effect Slides.**—My way to register is to mount effect slides in separate single carriers, after which I place them in the lanterns and make them register (by cutting the carriers or glueing a piece of wood on); then I make a notch, or knock a piece of wire in the top part of the carrier, so that I cannot put them further in the lanterns. If the object glasses are in focus, they should always register. I prefer using separate views for day and night, and always (when circumstances permit) use the single-drop carrier, with opening at top for ordinary slides, and by the dissolving tap light up the next lantern *very faintly*, which enables me to see, long before the audience would notice it, if the slide registered properly, if not a little movement one way or other soon puts it right. Mr. Malden has his slides mounted in single carriers, and are *made to register* properly when first mounted in *the carriers.—E. R. SHORT.*

[52780.]—**Bath Heater.**—J. H. Humphriss apparently has an exceedingly poor gas supply. To heat 40 gallons of water from 50° to 98°, say, in twenty minutes, he will need a ¾in. bore gas main. If he will communicate with me, and state what his gas supply is, I will set him right.—THOS. FLETCHER, Museum-street, Warrington.

[52780.]—**Bath Heater.**—In reply to J. H. Humphriss, I wish to state that I have had fitted a number of baths, full size make, the water of which has been raised from a temperature of sixty degrees to upwards of ninety in from four to seven minutes, 45 gallons. The baths were manufactured by the late Nathan Defries, of the Euston-road, and cost about fifteen pounds, the boiler consisted of thin flat copper tubes, tinned, and about 4ft. long, in number about 12, and 2in. wide, connected to a similar tube at each end, and placed side and flat ways alternately. The boiler was fixed to the bottom of bath by means of two large union joints, and about 2in. distant from it. The burner was made from round copper tubes, the same length as boiler, and as many tubes; it was pulled out at foot of bath and was attached to an indiarubba tube. The quantity of gas burned would cost about twopence.—W. R. BOUSFIELD.

[52781.]—**Battery for Lamp.**—I use similar battery, though not for lamps. By your description it appears as if the carbon (i.e., 1in. square) was in the porous cell. Again, your surface does not agree with "E. F. F."s. Carbon should be at least as wide as the zinc, and should be placed in outer cell. I am rather in favour of chloride of zinc for porous cell, though ch. of am. certainly keeps the zinc cleaner.—R. HANNEN.

[52781.]—**Battery for Lamp.**—Mr. Hargreaves is only experiencing what everyone else does, who, in spite of warning from those who know the facts, endeavours to get light from batteries. There is no battery in existence which does not make the cost some twenty times that of gas, in addition to the trouble; and, what is more, there never will be, unless the products are of value, and that never will be on any large scale, because the market would be at once glutted.—SIGMA.

[52782.]—**Dynamo.**—Does "Wag" work his dynamo while the battery is coupled up to the magnet? If he does, and the magnets are properly worked and connected, he ought to get about sixty ampères of current. But I suppose he is working it as a circuit dynamo, without the battery. Then the size of wire on the armature is certainly too small, and the quantity too great. Put only 2lb. of No. 18, and you will probably get a better result. Are you quite sure that you have connected it right up, and that you are not sending the current round the magnets in such a way as to get reversed poles. Four magnets are very unusual for a Siemens' H girder armature.—S. BOTTONE.

[52784.]—**Pedal Reeds to Harmonium.**—It seems unnecessary to furnish instructions how to make a harmonium pan, as the information has very recently appeared in the "E. M.," through the kindness of Mr. S. Mayer. I cannot exactly refer to number in which the information appeared, but if I remember right, it is in the last volume but one—viz., Vol. XXXVI. This, with the information furnished below, will, I believe, be all that is required by the querist. Make the channel for the lowest bass note—viz., 16ft. C, 6in. long and 1in. deep, and in width ⅛in. wider than the vibrator. The 8ft. C may be 5in. in length, ¾in. deep, and in width a trifle wider than the vibrator. All the other channels may be made in proportion to this; but each channel should be spaced out to suit the compass of the pedal board. To accomplish this, it is merely necessary to have wider divisions between each channel or tube to that which is employed in the construction of an ordinary harmonium pan. When "Station Master" has completed his pedal action, I should be exceedingly obliged if he would make known the result of his undertaking, and if any difficulties occur previous to this, if he will kindly state what they are, I will endeavour to help him to remove any difficulty.—G. FRYER.

[52786.]—**Tricycle Crank.**—Long cranks in practice are found to be very fatiguing, and from long experience of cycling, I should not like to recommend them to anybody. If "J. K. T." will send full particulars of the machine he intends ordering, with its weight, height of wheels, and whether geared up or down, and pattern, with particulars of himself, and the purposes to which he intends putting the machine, I will help him.—S. RICE.

[52787.]—**Boiler Query.**—If your mud covers are of the common type—viz., held against the boiler by a crosshead—make the joint with horse manure; but should they be cast-faced covers, fitting against a cast-faced mouthpiece, make them with small copper wire, or ⅜in. dia. composition gas-piping.—J. F. W.

[52787.]—**Boiler Query.**—If the boiler is working exactly under the same conditions as before, and with the same attendant, then I should think the fault lies with the jointing materi[illegible] all events, if the surfaces are planed or turned, y[illegible] might try asbestos tape, as advertised in [illegible] or lead wire.—LABOR OMNIA VINCIT.

[52787.]—**Boiler Query.**—Perhaps "A. G." h got his ropeyarn too thick, and that will allow to burn away and cause them to blow; and if th ones do not answer, let him try some sheet zinc and cut some joints out of it; put tallow or whi lead on them; the former is the best to leave t lid and boiler when being changed.—PHOT GRAPHER.

[52787.]—**Boiler Query.**—If mudhole joints ha been made good with hempen rope and red and whi lead, they should be so again, unless the rope is b and rotten, or the edge of mudhole is weakened l wasting from corrosion, which I know is ve common about these holes. If the plate is wast at edge of hole, it will spring in tightening u Try Asbestos millboard cut to shape, after bei soaked in boiled linseed-oil from six to twelve hour The cause and remedy can only be given on e amination by a competent inspector. You say th used to stand for months. I assure you they woul not stand so many months for me, as they shoul be opened at least every three months for cleanin and examination, however favourable the workin conditions. The fault may really lie somewher here, in slight defects having crept on unobserved —BOSWELL.

[52787.]—**Boiler Query.**—To "A. G."—I seems rather strange to me that your mudhole doo should keep tight three or four weeks, and then begin to leak. Do you use anything to prevent boiler from scaling? I once knew a case where I could keep the joint quite tight until I commenced using common soda as a preventer from boiler scaling. Then I was obliged to get a new block put on, and mudhole door to suit. I suppose your faces will be good, as you have had the boilermaker to examine it. Then I should try a joint as follows: From an old indiarubber bucket or live ring valve, cut a strip, say, about ¼in. or ⅜in. thick the required length, and join the ends together by a piece of twine, and get some blacklead and make into a paste: then put well on to the block face, and likewise the rubber (to prevent sticking). I think you will find it makes the best and cheapest joint in use; in fact, I have some that have been in use four or five years, and always tight.—FIRER, Dewsbury.

[52788.]—**Papier - Mache Ornaments.**—1. The pulp is boiled in a solution of gum arabic or of size. 2. The pulp is poured into the previously oiled moulds and then pressed with a counter mould to make the cast nothing more than a crust or shell as in plaster casts. 3. The moulds are either o wood or metal. 4. Directly the pulp is a little se the casts are black varnished and then placed in a heated oven.—JOHN HALE, Univ. Coll. London.

[52788.]—**Papier Mache.**—To make papier maché, the pulp is mixed with a solution of lime starch, or gum, and it can also be mixed with san of various kinds, chalk, &c. It is then pressed int the required shape, and linseed oil is spread ove it. The next step is to bake it; and, lastly, it i varnished. Metal moulds would be the best bot for standing the heat and giving a good, clear impre sion of the article required.—W. HENLEY RICHMON

[52790.]—**Indiarubber Gas Tube.**—The onl really effective remedy to prevent rubber tub smelling is to cut some strips of tinfoil, wrap them closely round the tube, and wrap tape outside thi to prevent the tinfoil getting damaged. A coat o varnish on the tape will make it secure; but th result is a very stiff tube. The best way is to us composition, lead, or brass tube, and use rubb only for coupling, or for such parts as require to b constantly bent.—THOS. FLETCHER.

[52791.]—**Indiarubber Gas Tube.**—This ques is answered by "Nun. Dor." on page 71 (No. 9 of present volume. It is, however, unsatisfacto for the parties concerned, as he says that there no remedy, and special tubing ought to be procure I think, however, before giving it up as a bad jo I would try varnishing the tube with two or thr coats of varnish: say shellac dissolved in naphth I don't believe any smell would get through thi At any rate, it is worth trying.—R. A. R. BE NETT.

[52794.]—**Toning Prints.**—Do not print un you get a purple-black, but a darkish shade of re and then tone with any of the multifarious solu tions used for the purpose, until your pictures ha a blueish-purple tint. This will allow for a slig return of the raw umber colour in fixing.—JO HALE, Univ. Col., London.

[52797.]—**Joining Electric Wires.** — I ha always found that simply bending the two wi round each other answers perfectly well. T indiarubber or silk should be cut off the ends of t two wires, and they should be twisted togeth several times to make sure that the surfaces are contact. After this, paraffined silk should be wou round the join. I believe joints made in this w are really quite as good as when soldered; but n of course, so strong.—R. A. R. BENNETT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Ditton" has replied to 52067; "London Stone," 52258; W. J. Grey, 52389, 52430.

52213. Electric Launches, p. 250.
52214. Boring Tools, 250.
52222. Chemistry and Dyeing, 250.
52224. Lantern Microscope, 250.
52241. Defective Ejector, 251.
52248. Trustee, 251.

52446. Model Boiler, p. 330.
52447. Boiler for Model Engine, 330.
52448. Peat Litter, 330.
52450. Fatty Acids, 330.
52452. Annuities, 330.
52453. C.R. Locos., 330.
52459. Watch Winding, 330.
52469. Fire and Marine Insurance, 331.
52473. Millstone, 331.
52481. Battery, 331.
52492. Legal, 331.
52494. Violoncello Making, 331.
52495. To "Jack of All Trades," 331.
52499. The Westinghouse Engine, 331.
52501. Watchmaking, 331.
52502. Telescopic, 331.
52503. Gas Black, 331.
52506. Windmill, 331.
52507. Photometer Dark Room, 331.

QUERIES.

[52799.]—**Microscope Eyepiece.**—I have been trying to grind a lens for the eyepiece of a microscope, but have not quite succeeded to my satisfaction. Will Mr. Lancaster, or other reader, give me a few hints?—(1) After rough grinding in the lathe, should the lens be finished and polished in the lathe, or by hand grinding in the metal "tool"? (2) If in the lathe is it better that the lens should revolve in the lathe, or the tool, and the lens held in the hand? (3) I find my concave tool alters in radius during the process of grinding. How can this be prevented? (4) As the proportion of the eyelens to the field lens is as 1 to 2, is it necessary that this ratio should be exactly maintained, or only approximately? (5) After the lens is finished and polished, how can I ascertain its exact focus?—Micro.

[52800.]—**Insulation.**—Will any of "ours" kindly mention a work on the manufacture of guttapercha and indiarubber for insulating purposes?—Megohm.

[52801.]—**Examinations.**—Will any reader be kind enough to recommend the best textbook for the Honours Grade in Electric Lighting and Transmission of Power in the City Guilds Examination?—Megohm.

[52802.]—**Blueing Cotton.**—Will Mr. A. H. Allen, or any correspondent, oblige by saying how to give the blue shade to bleached cotton yarn and calico after leaving the bleach bath without being spangled?—Bleacher.

[52803.]—**Tuning Forks.**—How made? How tempered? whether hard or soft? sort of steel? how tuned? tuned before or after tempering? size of forks for Lissajous' experiments? size and shape of prongs? how small mirrors are made and fixed? should forks have holes for that purpose? should handle be screwed for fixing to stands, &c.?—Phosphorus.

[52804.]—**Kaleidophone.**—Best form of? size and length of rods? how fixed to foot? reflecting heads—where can they be got? is the foot best of metal or wood?—Phosphorus.

[52805.]—**Weber's Wave Canal.**—Wanted dimensions of?—Phosphorus.

[52806.]—**Steel Bronze on Brasswork.**—How is this appearance produced?—Phosphorus.

[52807.]—**Power for Circular Saw.**—Any advice upon the following gratefully received. A mile of 3in. internal diameter iron piping taps a lake of 10acres area at an elevation of 200ft. above its lowest end. The course of this pipe passes over two undulations, the last of which is only about 80ft. below the level of the lake. An oscillating water engine at the lowest point in the main (where the registered pressure is 90lb. per sq. in.) has on trial failed to give any approximate power through the negative friction in the long length of piping. Would this diameter of piping provide a volume of water sufficient for a turbine or overshot waterwheel to develop, say, 8 horse-power for circular sawing machinery, and what would be the minimum size of each?—considering that economy must be studied in the choice of either turbine or wheel.—Shadowless Man.

[52808.]—**Knocking Inside Cylinder.**—Will any practical engineer give me any information as to the cause of knocking inside cylinder? It is a low-pressure beam-engine, Mather and Platt's piston. After a careful examination, I find that the brasses and gearing are tight and firm; but when two-thirds of the weight is taken off, and sometimes even when the full weight is on, I find that there is a constant knock or bump when the piston is at the bottom only. The engine is 108 indicated horse-power, 6ft. stroke, 29 revs., 40lb. pressure, cyl. 32½in. The valves are lifted by cams; the top valve has ¼in. lead, 5-16 lift = 9-16 lift; bottom valve 3-16in. lead and 3-16 lift = ⅜ lift; steam cut off at one-third of stroke; exhaust opens two-thirds of stroke. And also as to what will be the result if the air-pump foot and delivery valves are leaky and bad? And what is the result if the air-pump draws much air through the gland? Any information will oblige.—Engineer Jack.

[52809.]—**G. E. R. Goods Engines.**—Various illustrations of these engines appeared in last volume, but will not Mr. Brewer, or other correspondent, give some of the chief dimensions, without which illustrations are little good? Can any correspondent also give chief dimensions of the rebuilt 7ft. 2in. singles, such as 299?—Le Bœuf.

[52810.]—**Jam.**—I shall be greatly obliged for any information relative to the manufacture of jam on a business scale—details of process, plant required, and cost of same. Could it be made profitably in the country?—A. B. C.

[52811.]—**Empire Work.**—Can any reader kindly inform me by what process the gilding was done on clocks, candelabra, &c., during the first French Empire period? Detail would oblige.—Nap.

[52812.]—**How to Cause Tar to Dry Quickly.**—Could any of your readers suggest a treatment of ordinary coal tar to cause it, when applied to any surface, to dry quickly? Is there any cheap chemical I could add that would answer the purpose?—Inquirer.

[52813.]—**Boiler for Model Engine.**—I have a small engine, cylinder 2in. stroke 1in. bore. Will some one kindly tell me what would be the cheapest form of boiler (and size) to work the same well? Must it necessarily be riveted? I should also be glad to know probable cost of getting one made.—J. E. H.

[52814.]—**The Clun Stone Circle.**—It will perhaps be remembered that some 18 months since "F.R.A.S." kindly gave me some information, by the aid of which I hoped to ascertain whether the overthrown monolith, now lying some 120 yards towards the S.E. of this circle, was duly in line with the point of lowest sunrise, as seen from the centre of the circle. I believe I promised to report the result of the tests I designed to the Mechanic. I now make a tardy fulfilment of that promise by expressing my astonishment at finding by visual observation that the stone lay on the 21st of December last eight degrees too far S. of the exact line. I am unwilling to believe that the stone has been moved since it fell. If we suppose the stone to have originally indicated the point of lowest sunrise, that is ten days later than the 21st of December, will "F.R.A.S." kindly tell me how much of these eight degrees might be subtracted? Also, to account for the remaining differences: whether there is any good reason to think a change has taken place in the inclination of the earth's axis since Neolithic times? I ask the latter question because I see that Mr. Petrie, author of "The Pyramids and Temples of Gizeh," seems to account for the inexact orientation of the Great Pyramid in this way: He shows this pyramid to have been built in the transition period between the bronze age and the iron age of Egypt, which date might well be contemporaneous with our Late Stone age, as the successive waves of civilisation of course would sweep westward but slowly. Can any reader tell how much the Great Pyramid is out of true line?—Neo.

[52815.]—**Sunsets.**—The sunsets and sunrises have lately been very beautiful and surprising. I see some attribute the colours seen, and the blue sun and blue moon, &c., to the effect of dust from volcanoes high up in the air. Ought not the colours of the stars to be affected, and has anything of this kind been observed?—Edwd. Thos. Scott.

[52816.]—**L. & S.W.Ry.**—Will "Meteor," or other loco. correspondent, kindly give dimensions and sketch of the new bogie express engine 454, built by Messrs. R. Stephenson and Co., Newcastle, last year, and oblige?—H. N.

[52817.]—**S.E.Ry.**—Can any other kind correspondent give particulars of single driving engines of 81 class on this line?—H. N.

[52818.]—**Clamp Bricks.**—Will some brother reader of "ours" give me a little information on the manufacture of clamp bricks? I have a piece of land with some clay on it, and I want to know what kind of cinders or ashes is used, and the proper quantity, to be mixed with a cubic yard of clay. Could I make the bricks by machine? are the bricks put close together or open in the clamp, and how is the fire started?—A Four Years' Reader of the "E. M."

[52819.]—**Steam Brake.**—Will Mr. Stretton, or any other engineering reader, give a sketch of "sledge brake" introduced by Mr. McConnell on the North-Western Ry.?—Historian, M.I.M.E.

[52820.]—**Lickey Incline.**—I shall be glad to know the length and gradient of this incline. Also details of an engine specially constructed in America to work it.—Historian, M.I.M.E.

[52821.]—**N.E.R. Bogie Engines.**—Will any correspondent oblige with details of the new North-Eastern bogie engines which are being constructed by the Company, which, it is stated, will run the East Coast expresses?—Historian, M.I.M.E.

[52822.]—**Links in Locomotive History.**—Can any of your readers remember some broad-gauge engines built by Sharp, Stewart, and Co., 1846-7, for working between Bristol and Gloucester? If so, will they oblige with some details, and state if these engines are still at work?—Historian, M.I.M.E.

[52823.]—**Electric Lamp.**—Will "Sigma," or other kind reader, say what form of electric lamp and battery would be most suitable to use in a small laboratory to notice the gradations of colour in volumetric analysis?—Gas-Lamp.

[52824.]—**Curing Albatross Skins.**—Will some correspondent please inform me how to cure and clean a couple of albatross breasts? They smell very fishy—having been in their raw state for some months.—S. G. Bryant.

[52825.]—**Regulating and Dividing Current.**—A dynamo is driven by a steam-engine at an even rate, and gives a current equal to 40 Bunsen cells. In what manner can the current be best regulated and subdivided in the laboratory to give one or other cell power without altering the speed of the engine? Can it be done by interposing resistances? And if so, what approximately would be required to absorb the power of one cell?—Lecturer's Assistant.

[52826.]—**Cleaning Binding Screws of Bunsen Batteries.**—Will some one kindly suggest means of cleaning binding screws of Bunsen batteries? The holes and inside parts of the clamps get very foul, and with a large battery cause a great deal of bother to a—Lecturer's Assistant.

[52827.]—**Ramsbottom's Scoop for Locomotives.**—To Mr. G. Pinnington.—I presume that by g is meant the velocity which a body would acquire in one second due to the action of gravity = 32. Suppose that the velocity of the engine in feet per second to be 60; then $\frac{60^2}{32 \times 2} = S = \frac{3600}{64} = 56{\cdot}25$ft. Please say whether I am correct?—Feed-pump.

[52828.]—**Bad Throat.**—Would any of our medical readers be kind enough to say what would be good for my throat? I have been under one doctor, and he said it was relaxation of the uvula, and gave me a blister, and something to paint the inside of my throat; but it did not answer. Another doctor cauterised the papilla of my tongue, gave me a medicine that caused me to feel sickly, and to gargle with alum-water; but it does not do. Symptoms: A tickling sensation in my throat which causes me to cough; but there is no phlegm or saliva with the cough. If I walk uphill quickly I feel very short of wind, and the cough is very troublesome. Same if I exert myself with physical labour. Yet when I am at rest I feel all right.—Harry Bhill.

[52829.]—**Manchester v. London Expresses**—I trust your readers will not let this most important discussion drop out of sight. The G.N. and M.S. and L. Ry. Companies have the longest route, yet have "determined to run in as short time as the others, no matter how much the others reduce." This is war to the knife, and is bringing up the single and coupled engine question again. The L. & N.W. Co. propose to reduce the weight of trains, and put the Lady of the Lake class of engines to run them. It therefore only remains to be seen what the Midland will do to regain its Manchester traffic. I shall be glad to hear Mr. Grey's views on single or coupled engines for working such special service expresses.—Historian, M.I.M.E.

[52830.]—**Coal-burning Locomotives on M.Ry.**—Relating to the testimonials to Mr. Speight, a correspondence has taken place in the *Times* with regard to improvements introduced on the Midland Railway. One claim is that Mr. C. Markham was the first to design coal-burning locomotives on the Mid. Ry. Now, with all due respect to the "leading journal," I doubt the fact. During Dec. 1857 and Jan. 1858 I well remember seeing two goods locomotives under construction at Messrs. Beyer, Peacock, and Co.'s works in this city. These two engines were to burn coal on the Mid. Ry., and, in fact, did burn coal on that line before the Markham system was perfected in 1859–60. From the moment the two engines in question left Messrs. Peacock's works, I have neither heard nor seen them. Would any kind readers oblige me with their numbers, and any details of their working?—Historian, M.I.M.E., Manchester.

[52831.]—**Reagent.**—Will Mr. Allen, or other of our chemical readers, give the most delicate reagent to use for neutralising an acid liquor? I have tried phenolpthalein and dimethaniline orange, and have had to go back on freshly-prepared "litmus solution," as I find the two above-named reagents are not nearly so delicate as "litmus."—Brine.

[52832.]—**Legal.**—To Mr. Wetherfield.—I hold a place in Ireland on lease assigned by previous tenant. Previous tenant owed Income-tax (sched. A) for two years previously. I refused to pay for the one year when the old tenant was entirely in possession; but paid for second year, when I held for part time, and for the last three years. Collector has acknowledged receipt of the money each time; but refuses to hand me the proper receipts until the year's tax owing is paid. Can he legally do this?—E. Hall, Little Island, Cork.

[52833.]—**Water Heater.**—I have an engine 12h.p. (non-condensing) and a boiler 20h.p. Would any legal friend express opinion what sort of heater would suit best for heating the feed-water by exhaust steam from the engine, but not to mix the steam with the water? Would it keep any deposit out of the boiler? I should like it so that I could clean it out. We use much more steam, independent of the engine.—W.

[52834.]—**Damp Schoolroom.**—Can any reader of "ours" suggest a remedy? It is of iron outside, then felt, then matchboarded. Ridge roof, with ventilators always open. Zinc tubes from floor rising about 5ft. around sides. Slight current only circulates through these. Brick foundation on fairly dry soil. Being a Sunday-school, it is not open much. Windows open on top only. Which is best—windows and ventilators always open, or room kept closed up?—A. E. B.

[52835.]—**Calculation of Cometary Orbits.**—Arago, in his "Popular Astronomy," says that if you have three good observations in Right Ascension and Declination you can, by means of a simple calculation, determine the elements of the comet. To effect this, he says, you have to take the six elements of a planet's orbit (inclination, semimajor axis, eccentricity, longitude of perihelion, longitude of ascending node, the longitude of the position of the planet at a given epoch), from which you get two equations. You then take three observations in Declination and Right Ascension, and insert them in the two above-mentioned equations. You can get six equations, which give the six elements of the new body. Would any astronomical reader explain the above method? Also give me a list of the elements of the comets which have appeared from 1874 to present date.—C. E. Tweedale.

[52836.]—**Daniell Cells.**—I have a number of the above cells, which cause me a deal of trouble. The solution in porous pot becomes charged with sulphate of copper, which if precipitated on zinc, causes the evolution of the current to be intermittent. Are the porous cells too porous, or is it from the unavoidable osmosis? The solutions are nearly the same density, as I use solution of chloride of sodium for porous cell.—Perplexed.

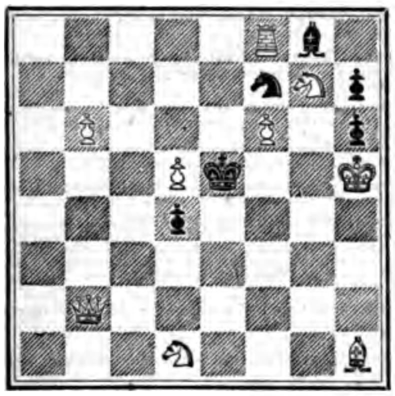
[52837.]—**Storage Battery.**—Will any correspondent of this journal kindly give directions to make a storage battery to drive a Trouvé motor, the armature of which is 8in. long by 4in. diam.? A sketch would oblige.—W. T. Smith, Dunedin, N.Z.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXXI.—By SOPHIE SCHETT.

Black.



White. [9+6

White to play and mate in two moves.

SOLUTION TO 869.

White.	*Black.*
1. Q-Q 8	1. K-K 3 (a)
2. Kt-Kt 4	2. Anything
3. Q mates	
	(a) 1. K takes Kt (b)
2. Q takes P	2. Anything
3. Q or B mates	
	(b) 1. R takes P
2. Q takes P (ch)	2. K moves
3. Q mates	

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 868 by D. Mackay (eight variations only given), Silvertown (ditto), T. H. Billington; to 869 by R. A. Bennett and F. K. (but all variations must be given).

D. MACKAY.—869 can nearly be done by your method; but there appears no mate if 1. $\frac{}{\text{K-K 3}}$; if 2. $\frac{\text{Kt-Kt 4}}{\text{R takes P}}$.

A. SCHMUCKE.—Your solution will not do; if 1. $\frac{}{\text{K-K 3}}$ 2. $\frac{\text{Kt-K Kt 4}}{\text{R takes P}}$ 3. Q-K 4 is not mate as Kt can take Q.

"E. M." Correspondence Tourney Game between Messrs. Vincent (*White*) and Blake (*Black*):—

(Ruy Lopes.)

1. P-K 4, P-K 4 / 2. Kt-K B 3, Kt-Q B 3 / 3. B-Kt 5, Kt-B 3 / 4. Castles, Kt takes P / 5. P-Q 4, B-K 2 / 6. Q-K 2 (a), Kt-Q 3 / 7. B takes Kt, Kt's P takes B 8. P takes P, Kt-Kt 2 / 9. Kt-Q 4 (b), Castles / 10. Kt-Q B 3, Kt-B 4 / 11. R-Q sq, Q-K sq (c) / 12. Kt-B 5, P-B 3 (d) / 13. B-R 6, Kt-K 3 / 14. Q-Kt 4, R-B 2 15. B-K 3 (e), K-R sq / 16. Kt takes B, Q takes Kt / 17. P takes P, Q takes P / 18. Kt-K 4, Q-K 2 / 19. Kt-Kt 5, R-B 3 / 20. Q-K 4, R-Kt 3 / 21. P-K R 4 (f), P-Q 4 (g) / 22. Q-K 5, P-K R 3 (h) / 23. P-K B 4 (i), P takes Kt (k) / 24. P-B 5, Q-B 3 / 25. Q takes Q, R takes Q / 26. P takes Kt, B takes P / 27. B takes Kt P, R-Kt 3 (l) / 28. R-Q 3, B-B 4 (m) / 29. R-Q B 3, R-Q Kt sq / 30. R-K B sq, B-K 5 / 31. R-K Kt 3, R takes P (n) / 32. P-R 5, R-K 3 (o) / 33. R-B 8 (ch), K-R 2 / 34. R-B 7, R takes Q B P / 35. B-B 4, R takes K Kt P (ch) / 36. R takes R, B takes R / 37. K takes B (p), P-B 4 / 38. R takes B P, P-R 3 / 39. K-B 3, R-K 8 / 40. R takes B P, R-K B 8 (ch) / 41. K-K 3, P-Kt 4 / 42. P takes P *en pass.* (ch), K takes P / 43. R takes P, R-K 8 (ch) / 44. K-Q 4, R-Q 8 (ch) / 45. K-B 4, R-K B 8 / 46. R-Q 6, Resigns.

NOTES.

(a) The usual move here is R-K sq.

(b) Although this move (Winawer's) tends for the moment to retard Black's game, we prefer the book move, B-K 3.

(c) Black's game is cramped B-R 3 is not so good as the text move, however, as the attack must be on the K side.

(d) If P-Q 3, White wins by 13. Kt takes B (ch), &c.

(e) If 15. $\frac{\text{R-Q 3}}{\text{K-R sq}}$

(f) White still keeps up his attack.

(g) At last!

(h) A mistake. Q-B 3 is quite safe.

(i) A good rejoinder.

(k) If now Q-B 3, White could still play P-B 5.

(l) So ends Part I. of this game. Forces pretty equal, after all this fighting White at once starts a new attack out of the remains of the old, giving Black throughout the game not a moment's rest.

(m) Inviting; but perhaps P-B 4 would be safer.

(n) Another mistake. He should have played R-K 3; but the bait was tempting.

(o) Could not Black now have ventured R takes B, followed by R takes Q B P?

(p) Black now feels the hook. The result of his 32nd move is the loss of his B, and so of the game.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 23, and unacknowledged elsewhere:—

V. BICHOT.—Geo. Pearson.—Walker and Co.—Barnett and Foster.—Lt.-Col. Hunter.—Selig, Sonnenthal, and Co.—Dr. Mantell.—Rev. A. Willan.—Major Watkin.—H. Milnes.—J. S. Queen and Co.—Albo.-Carbon Light Co.—A. S. L.—J. H.—A Fellow of the Royal Astronomical Society.—Lt.-Col. Ross.—J. S. C.—J. H.—T. A. Wilhelm.—T. Richards and Co.—B. Baugh.—David.—Engine Driver.—W. Routledge.—Old Rug.—D. W. Williams.—P. Ward.—E. D.—Cosmos.—E. E.—J. Isherwood.—R. Hannen.—A. Watkins.—T. Taylor.—Augustus.—Iolanthe.—Chemicus.—Thomas Thompson.—Organic Chemist.

JNO. ATKINSON. (The process is much too long, and can only be carried on with proper plant. It is obtained by the destructive distillation of wood, and is distilled off the crude pyroligneous acid.)—Q. M. S. (How can any one answer such a question without more details? The battery solution is, however, most likely sal-ammoniac.)—APPRENTICE. (Do you mean how much? If so, it depends on how it is laid on. You can easily make the calculation yourself.)—W. J. (We do not know one that can be recommended. There is very little done in your trade there. 2. We are not sure, but think it is by Mr. Abbott.)—T. H. P. (See the queries inserted last week. It is expressly stated to be suitable for lighting—that is as suitable as any practically free from fumes.)—DEMETRIUS. (Inquire of any bookseller. 2. We have not heard of any accident of the kind. 3. There are two handbooks published by Lockwood and Co., but they are intended primarily for apprentices and the trade.)—AVE ET VALE. (Under the circumstances, do you think he would offer an opinion without seeing the patient? Refer to what he said on pp. 310, 478, Vol. XXXV. Glucose is $C_6H_{12}O_6$; sucrose is $C_{12}H_{22}O_{11}$.)—J. H. B. (It might answer if you can keep up the blast; but we should prefer one of Fletcher's furnaces.)—DOT. (No doubt you were answered in this column and referred to p. 21, Vol. XXXII. You can change your name as often as you please; but if you expect property to be left you had better consult a lawyer, who will see that the change is properly enrolled.)—VOLT. (It is impossible to give sketches and ask questions of the kind for every size that our readers may desire to make. You must see what has been said before, and experiment on that.)—ASSISTANCE. (There is only one way of setting the ordinary pattern. All you have to do is make the flue in a spiral.)—THOS. BOOT. (Magnesium wire or tape. It is a metal. Watch replies 52620.)—E. S. (Doubtful if there is anything that will do what you want.)—MARLOW. (The Léclanché—see indices.)—J. GREEN. (We have given hundreds—see the indices. The cheapest is made with logwood and sulphate of iron.)—PHOTO. (You have not made it soft enough. Properly made, it would lift 40lb. with adequate battery power.)—YOUNG STUDENT. (You will find something about it in back volumes; but not much can be done.)—ELECTRIC BELL. (A knowledge of electricity. Any of the usual text-books. See previous replies.)—C. K. (You will get an idea from p. 256, Vol. XXX., or better on p. 493, Vol. XXVII. The cure for neuralgia is given on the authority of an American physician. We should think the direct application of the current the simplest and best plan.)—W. H. ANGIER. (The Westinghouse coupling was illustrated on p. 196, Vol. XXXV. 2. We do not know where to find the list of temperatures required.)—R. E. (You will find a great deal about Psycho in Vols. XXV. to XXVII. The explanation generally received is a concealed human being.)—J. W. GREEN. (Have you any idea of the plant you would require to make an incandescent lamp that you can buy for a few shillings? See recent numbers as to the battery power required—p. 437, last week, for instance.)—J. R. JACK, LARGS. (See p. 426, Vol. XXXVI., and the indices of the last three volumes. The glass need not be thick. It can be cut to a circle with a diamond, and the centre hole should be round. You do not appear to be aware that the question has been recently fully discussed.)—HEAT. (Use the tables already calculated, such as can be found in Molesworth's Pocket-Book. 50lb. steam (atmosphere included) has a temperature of 281° Fahr. You confuse units of heat with degrees of temperature.)—BENDIGO. (Nominal horse-power is utterly useless. 2. It depends entirely on the pressure of the steam and the speed of working. A cylinder 2in. stroke by 1in. diameter would drive most of them with a pressure of 40lb. of steam.)—WM. JAMES. (Yes, they will do, but special forms are advisable, as the heat concentrated on the slides rapidly destroys the latter.)—A READER. (What you have used produces a stain, whereas you apparently want a japan. See the indices for several recipes.)—ENRIQUE. (They are made of glue and treacle, about 1lb. of best glue to 4lb. of treacle. Dissolve the glue after soaking, add the treacle; boil for a couple of hours and pour into moulds. Use more glue in hot weather.)—IMPROVER. (There is Buchan's book published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 4s. You know the articles in this paper by Mr. Davies, we suppose.)—DORA. (We do not quite understand you. Women can claim their "rights," as a rule, at any time; the difficulty, perhaps, being a previous agreement between the sexes as to what those "rights" are. If you mean, Can you receive the interest of money left to you before you are 21?—that depends, we suppose, on the terms of the trust created by the person who left you the money. What does the will say?)—A. H. K. (The *Times*; at intervals during January.)—LAMB. (At that time of the evening, this time of the year, you ought to have had a light; still, if the other facts are as you say, we should advise you to consult a solicitor with a view to claiming compensation from the driver who ran into you.)—RAMCHULLUNDER. (If the solicitor does not receive costs from the debtor, his own client is, of course, liable—is that what you mean?)—AMOS. (None that we know of.)—J. S. C. (We cannot ask correspondents to enumerate the requisites for successful inventions. The only qualification for notice in these pages is merit or novelty.)—T. J. O'C. (Our space does not permit, except in very exceptional cases, of the reproduction of problems from books.)—ZERO. (Consult a respectable solicitor, and tell him all you have told us. The cost will be trifling, and you will get the thing done at once. If you begin to consider the different opinions you would get in reply to your query in these columns, you will never do anything at all. No man who has any proper regard for his wife and family ought to rest easy until he has made a proper will.)—J. B. P. (1. All depends on the evidence. If by any negligence you contributed to the lady's accident, you will certainly have to compensate her; on the other hand, if you did all you could to prevent it, and paid her doctor's bill afterwards, and the lady got about again in a few days, we should advise you to consult a solicitor with a view of defending any action that may be taken against you. Other query shall appear next week.)—J. S. B. (Use vulcanite or porcelain. The solutions cannot be kept too clean. Lead would certainly be acted upon.)—JEWELLER. (See the index of the last volume under Hands, perspiring.)—BENJ. TETLOW. (There is no work on the practical part of the subject; but information can be found in such books as Percy's "Metallurgy of Iron and Steel." Mixing and other details would depend too much on the character of the ores to be mentioned in a book, except in a general way.)—FRANCIS. (Any of the elementary textbooks would do; but perhaps Sir E. Beckett's "Astronomy Without Mathematics" (Society for Promoting Christian Knowledge) would be the best for your purpose.)—G. R. CARNAC. (The questions have been all answered so far as is possible in back numbers, and that recently. You will want 10 or 12 cells; double carbons, if you like; but see p. 379. Which new primary do you mean? We have described all, we believe. We cannot say, but it might be, if the lamp is of only one or two candle-power.)—A POACHER IN EMBRYO. (Surely, if the information is worth having, it is worth the cost of a number. For barrel-staining see p. 86, Vol. XXXV. 2. The Acts relating to the Preservation of Game can be bought at the Queen's Printers, East Harding-street, E.C. 3. Boots made of hippopotamus hide are said to be the best; but a pair of stout leather walking-boots, well greased, are good enough for most people.)—WM. M. (You will find one on p. 433, last week's issue. The other queries are of the nature of advertisements.)—AMATEUR. (We were not aware they are coated. There is nothing that will make them resemble meerschaum.)—EXCELSIOR. (We cannot determine which of Siemens' burners you mean; but they have all been described in back numbers. See p. 582, Vol. XXXII.; p. 373, Vol. XXXIII.; p. 588, Vol. XXXV.; also p. 443, Vol. XXXVI.)—W. B. (We do not understand you. Surely you would not turn a jet of steam into a smith's fire.)—ELECTRIC JACK. (There are plenty of instructions for electric bell-making and arranging in back numbers. It is impossible to say what is the matter with yours from the description sent. The wire (36) is rather fine for a magnet; 26 is quite fine enough for the size mentioned, and the finished coil should be about three times the diameter of the core. Read up what has been given, and you will no doubt discover what is wrong.)—H. A. (Perhaps he has the distemper. See the back volumes, p. 506, Vol. XXXVI., and elsewhere.)—LAUNCH. (It is a patent, and consists of a chamber filled with glass balls about the size of beads. See p. 412, Vol. XXXVI. 2. Smear over with a rag moistened with vaseline.)—PERUVIAN. (The only way is to get one and try. The inventor is a well known professor. Are you not mistaken as to the "settled climate"?)—B. BOLT. (It rests entirely with yourself. Follow the advice of the doctor.)—RUSTIC. (Answered many times. If you must have it permanent, grind the glass with flour emery.)—MICROSCOPIST. (You must be recommended by three fellows; pay two guineas entrance-fee, and two guineas annual subscription.)—HYDROGENIUM. (Mere personal opinion is useless; it is scarcely likely that anyone has studied in both.)—VERA SOLIDAQUE. (If leadfoil will not stop it, we know of nothing. You do not say the cause of the dampness.)—ALBERT HALL. (You could try caustic soda, or even a strong solution of washing soda.)—CHEMICUS. (Every one of your seven queries has been recently answered. Please consult the indices.)—ONE WHO SUFFERS. (The only remedy for ingrowing toe-nail is that given by Dr. Edmunds, p. 284, Vol. XXXIV. A piece must be cut out of the centre of the nail, from the front to as far down the quick as can be reached.)—H. R. B. (You will find much information in back volumes, but the calendar gives the actual work required. We believe Mr. H. K. Lewis, 136, Gower-street, W.C., publishes a guide.)—COQUETSIDE. (Known as the blue process, ferroprussiate, &c. See p. 325, last volume, p. 64, Vol. XXXVI., and the indices under any likely heading.)—A REGULAR SUBSCRIBER. (You should have mentioned the page on which previous answer appeared. That was written with your question before us, and was a direct reply. We do not know any reason why you should not learn to play the instrument. As to the other question: paper tubes will do. The expression is definite enough, but it should mean 300 times the size.)

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THE SIXPENNY SALE COLUMN.

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The Pyrophore, chemically self-lighting lamp, remaining, offered at 7s. 6d. Less than half price.

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The above complete with **Battery, Push**, and yards of wire, 8s.—LEWIS and SON, 1A, Lowndes-terrace, Knigh bridge, S.W.

C. Pilkington, 32, Sackville-street, Piccadilly, W Magic Lantern Artist and Photographic Colourist.

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Norwegian Anchovies, small kegs, carriage p to any station, 3s. 6d. each.—DRURY, 51, High-street, Hull.

Gas Engine (Crossley's), about 1-horse, £20, c £50; 1-horse engine, £4; 4-inch dead centre lathe, £3; combin engine and boiler, 3-horse, £26.—79, Dudley-road, West Bromwi

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 1, 1884.

THE PHYSICAL CONDITIONS OF IRON AND STEEL.

AT the meeting of the Institution of Mechanical Engineers, held last week, Prof. D. E. Hughes, F.R.S., read an important paper on "The Physical Condition of Iron and Steel," which is in some sense a complement to his paper on "The Molecular Rigidity of Tempered Steel," in which he advanced the theory that the molecules of soft iron were comparatively free as regards motion amongst themselves, whilst in hard iron or steel they were extremely rigid in their relative positions. Prof. Hughes has since then widened the field of research so as to embrace all the physical changes which occur in iron and steel, and the results he has obtained are embodied in the paper read last week. The primary object of the research was to discover if possible a method of ascertaining the physical condition of any piece of iron without destroying or changing its existing state; and Prof. Hughes believes he has attained the desired end by the application of certain phenomena of magnetism, which indicate clearly the slightest change in the molecular structure of iron or steel, no matter what may be the condition of those metals, or the size and shape of the pieces operated on. We need not stop to point out that any trustworthy method, which can be readily applied, of ascertaining the temper (using that word in its widest sense) of any given piece of iron or steel will be of the very highest value to engineers and mechanics in all branches; but will at once proceed to give such explanation of the method as is possible in our space, leaving those interested who may desire more detailed information to procure a paper which will be recognised as one of the classics of the machinist's library. It is well known to most of our readers that soft iron takes a higher degree of magnetism, and parts with it more quickly, than steel; also that tempered steel retains magnetism longer than does soft steel. It might be expected, therefore, that by the aid of an instrument which would measure the degrees of magnetism correctly, we should be able to include all varieties of iron and steel between the two extremes of softness (as in annealed iron), and hardness (as in high-tempered steel); but Prof. Hughes soon found that such was not the case when pieces of iron were magnetised to saturation or even partially so. However, by employing extremely feeble magnetising powers, such as the current from one Daniell cell reduced as found best for the dimensions of the iron, by passing it through resistance coils varying from 10 to 100 ohms, Prof. Hughes found that the following laws hold good with every variety of iron and steel: 1. The magnetic capacity is directly proportional to the softness or molecular freedom. 2. The resistance to a feeble external magnetising force is directly as the hardness, or molecular rigidity. With sixty different varieties of iron and steel Prof. Hughes has found that each has its fixed points, beyond which annealing cannot soften, nor tempering harden; consequently, if all varieties were equally and perfectly annealed, each would have its own magnetic capacity or its specific degree of value, by means of which its place and value could be at once determined. If a single specimen of, say, hard-drawn iron wire is taken, and its magnetic capacity noted, it is found that the value rises after each partial annealing, until an ultimate softness is obtained, which is the limit of its molecular freedom. Thus we can study the best methods of annealing, and find at once the degree of softness in any given specimen. Similarly, in the case of tempering, we may reach the ultimate molecular rigidity, and determine the state of any given piece. In soft Swedish iron Prof. Hughes finds that tempering hardens only 25 per cent. on the scale adopted, while mechanical compression, such as hammering, hardens 50 per cent. In cast steel, on the other hand, tempering hardens it 400 per cent., while mechanical compression hardens not more than 50 per cent. Between cast steel and Swedish iron there is a long series of steels and irons varying in hardness and softness between the two extremes. Prof. Hughes's theory of molecular freedom (as in soft iron) and molecular rigidity (as in cast steel) fully explains all the changes we are enabled to perceive and measure; but the theory is not necessary to understand the results attained by the aid of the instrument which Prof. Hughes has called the magnetic balance. This consists of a delicate magnetic needle 2in. long, suspended by a silk fibre so that its pointer rests near a fine black line indicating zero. The movement of the needle is limited by ivory stops to two-tenths of an inch on either side of zero. When the north end of the needle and its zero index are north, the needle rests parallel with its index; but the slightest external influence, such as a piece of iron a millimetre in diameter, placed at 4in. distance, deflects the needle to the right or left, according to the polarity of its magnetism, and with force proportionate to its magnetic power. If on the other side of the needle an exactly similar piece of iron is placed [illegible] the same distance, the needle returns to zero, because the two pieces of iron balance each other; and if we know the magnetic value required to balance the first piece, we know the magnetic value of both. The iron is placed at a fixed distance, say 4in., resting against a brass stop; its centre should be in line with the centre of the needle, and it should be placed at right angles to the needle, lying horizontally east and west, so as to be free from the directing influence of the earth's magnetism. On the opposite side of the needle at a distance of 12in., is the compensator, a powerful steel bar magnet (3cm. wide, 1cm. thick, and 6cm. long), which turns upon its axis, and carries a pointer to indicate the degree of displacement on the graduated circle. Generally, this bar-magnet is parallel with the needle, the pointer of the compensator and the needle being at zero; but when it is desired to measure the amount of magnetism in a piece of iron, the bar-magnet is made to pass through an angular displacement which balances the magnetic force in the piece of iron, and the index readings on the graduated circle are taken as the comparative values. In order to magnetise the piece of iron by means of an electrical current, a coil of insulated copper wire is placed near the needle, the iron then becoming the core of an electro-magnet. As this coil, independently of the iron, acts upon the needle, it must be balanced by another coil on the opposite side of the needle. The position and power of these coils is adjusted by a lever which enables the operator to find a position where the coils completely neutralise each other. Then a piece of iron being introduced into either coil, the balance is destroyed, and the magnetic influence of the iron core can be measured by means of the rotating compensator or bar magnet. A reversing key is used to change the direction of the current so as to observe any difference in the north and south polarity of the iron core. One Daniell cell is sufficient; but great care must be taken that its E.M.F. is a constant; otherwise its variations would be read as variations in the quality of the iron itself. In addition, a series of resistance coils from 10 to 100 ohms are required to reduce the current sufficiently to bring the whole series from soft Swedish iron to cast steel into range. When it is required to measure the magnetic capacity of pieces of metal varying very widely in dimensions, a series of coils will be needed; but the smallest may have a core opening of one centimetre (0·4in.), which will test rods just a shade smaller down to the finest needle. Great care and considerable practice is needed so as to insure that the iron is placed in a neutral field; but when the requisite conditions are once attained, several readings can be made in a few minutes. There are modifications in the manner of observing, such as magnetising all pieces to the same degree, and noting the amount of current required; but the method described will probably be found most useful.

By means of the magnetic balance Prof. Hughes has determined that annealing not only renders iron soft, but entirely frees it from all strains previously introduced by drawing or hammering. Thus, a bar of iron drawn or hammered has a peculiar structure which gives greater mechanical strength in one direction than in another; but if thoroughly annealed at high temperatures, it becomes homogeneous in all directions, and loses all traces of previous strains, provided there has been no actual mechanical separation into a distinct series of fibres. An instance of the influence of annealing on Swedish iron will be seen in the following:—Wire hard drawn gave 230° of softness as indicated on the balance; annealed at black heat, 255°; at dull red, 329°; at bright red, 438°; at bright yellow, 507°; at yellow white, 525°, which may be taken as its ultimate degree of softness, the maximum being obtained by annealing at a temperature just below that of fusion. Some difficulty was experienced in annealing all wires to the same standard, for steel wires rapidly lose carbon, while pure iron absorbs it. Prof. Hughes therefore made a tube white hot or otherwise, according to the temperature required; the wires were then quickly introduced, and withdrawn the moment they reached the same temperature, when they were allowed to cool in the air. The results of his researches may be thus formulated: 1. The greatest degree of softness is obtained by a rapid heating to the highest temperature below fusion, followed by cooling in a medium incapable of changing the chemical composition of the metal. 2. The time required for cooling varies directly as the amount of carbon in the alloy. In absolutely pure iron rapid cooling does not harden, whilst steel might require several hours or days, even for pieces one millimetre in diameter. Slow cooling has no injurious effect upon iron when cooled in a neutral field; consequently, slow cooling may be adopted in every case where time is no object. Care must be taken that the piece of annealed iron to be tested is not bent, hammered, filed, &c., for the hardening effect of a bend is most remarkable, and the mere cleaning of the surface with glass or emery paper hardens it by several degrees of the magnetic balance scale. The effect of annealing on several samples may be understood from the following:—Swedish iron had its magnetic capacity increased from 230 to 525; puddled iron from 212 to 340; Bessemer steel (soft) from 150 to 291; Bessemer steel (hard) from 115 to 172; crucible fine cast steel from 50 to 84. It follows that for making cores of electro-magnets, Swedish iron is the best that can be used, and the magnetic balance will, no doubt, be used in testing whether the annealing process has been carried as far as it possibly can be. In the case of tempering, that is, increasing molecular rigidity and the power of retaining magnetism, the following figures may be useful:—Crucible fine cast steel tempered at a bright yellow, cooled completely in cold water, had a magnetic capacity of 28; bright yellow, cooled completely in oil, 51; bright yellow, let down in water to white, 38; red heat cooled completely in water, 66; red heat cooled in oil, 72; and annealed, 84. The experiments carried out by Prof. Hughes show that just as there is no means of finding a distinct line between iron and steel by mechanical and chemical tests, so the physical method fails, for ordinary iron is physically a soft steel, and steel is a hard iron. All the series are hardened by tempering; all are hardened by mechanical compression, or by strains and stresses. At the extreme end of the series, towards pure iron, mechanical hardening has a greater effect than tempering; at the steel end tempering has a greater effect than mechanical compression. Prof. Hughes adopts the scale reading of 400° as the dividing line. All specimens that after annealing give a higher reading than that are classed as iron; if below, as mild or hard steel, according to their magnetic capacity. The molecular rigidity gives at once decreased magnetic capacity and increased electrical resistance, which agrees with hypothesis; and from some experiments made with a view of comparing tensile strength with magnetic capacity, Prof. Hughes thinks it will be some day possible to deduce not only electrical conductivity from magnetic capacity, but also tensile strength. We have said enough to prove that the magnetic balance is a valuable instrument, and it only remains to state that its use is free to all, as Prof. Hughes has not protected it by letters patent.

ASTRONOMICAL NOTES FOR FEBRUARY, 1884.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. p.m.	h. m. s.	° ′ ″	h. m. s.
1	0 13 47·56 ,,	20 58 14	17 10 38	20 44 26·69
6	0 14 17·65 ,,	21 18 27	15 42 1	21 4 9·46
11	0 14 27·73 ,,	21 38 20	14 6 44	21 23 52·23
16	0 14 18·49 ,,	21 57 54	12 25 37	21 43 35·00
21	0 13 52·73 ,,	22 17 10	10 39 29	22 3 17·76
26	0 13 9·15 ,,	22 36 10	8 49 14	22 23 0·53

The Method of finding the Sidereal Time at Mean Noon at any other Station will be found on p. 555.

Large and beautiful spots and groups of spots continue to diversify the Sun's disc. Faculæ, too, are exceptionally fine and numerous.

The Moon

Enters her First Quarter at 5h. 57·2m. a.m. on the 4th, and is Full at 4h. 47·9m. in the Early Morning of the 11th. She will enter her Last Quarter at 8h. 13·7m. a.m. on the 19th, and be New at 6h. 51·1m. in the evening on Feb. 26th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	4·3	3 43·6 p.m.
6	9·3	8 15·9 ,,
11	14·3	12 46·0 ,,
16	19·3	3 49·1 a.m.
21	24·3	7 41·2 ,,
26	29·3	11 53·6 ,,

The Moon will be in Conjunction with Saturn at [illegible] p.m. on the [illegible]; with Jupiter at 11 a.m. on the 9th; with Mars at 11 a.m. on the 11th; with Mercury at midnight on the 24th; and with Venus at 1 p.m. on the 29th.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
4	B.A.C. 1119	6	11 48 p.m.	Dark	130	171	12 34 p.m.	Bright	240	280
5	δ² Tauri	6	4 20 ,,	Dark	32	357	4 44 ,,	Bright	350	318
5	δ³ Tauri	5	4 56 ,,	Dark	137	105	5 54 ,,	Bright	245	223
6	119 Tauri	5½	8 16 ,,	Dark	96	95	9 31 ,,	Bright	264	283
6	120 Tauri	6	9 0 ,,	Dark	85	96	10 13 ,,	Bright	272	299
8	26 Geminorum	5½	1 40 a.m.	Dark	103	144	2 34 a.m.	Bright	235	276
8	68 Geminorum	5½	10 10 p.m.	Dark	24	23	10 55 p.m.	Bright	310	322
9	B.A.C. 2872	6	12 11 ,,	Dark	145	160	12 31 ,,	Bright	177	196
11	ω Leonis	6	†1 14 a.m.	S.S.W.	338	354				
11	16 Sextantis	6	6 31 p.m.	Bright	7	328	6 53 p.m.	Dark*	322	283
15	h Virginis	5	†12 24 ,,	N.N.E.	157	127				
16	λ Virginis	4½	‡11 19 ,,	Bright	100	63	12 15 p.m.	Dark	220	186
20	B.A.C. 5700	6½	5 40 a.m.	Bright	104	93	7 0 a.m.	Dark	243	244

* But seemingly bright. † Near approaches. ‡ Star has not risen.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Oc D	5	40	P.M.	9	I	Tr E	7	3	P.M.	19	II	Tr E	11	43	P.M.
1	I	Ec R	8	16	4,,	9	I	Sh E	7	34	,,	20	II	Sh E	1	10	A.M.
2	II	Tr I	3	6	A.M.	10	III	Oc D	2	17	A.M.	20	III	Tr I	7	25	P.M.
2	II	Sh I	3	46	,,	10	II	Oc D	12	26	P.M.	20	III	Sh I	10	25	,,
2	II	Tr E	6	1	,,	11	II	Ec R	4	22	20 A.M.	20	III	Tr E	10	59	,,
2	*II*	*Sh E*	6	40	,,	12	II	Tr I	6	31	P.M.	21	III	Sh E	2	1	A.M.
2	*I*	*Tr E*	5	19	P.M.	12	II	Sh I	7	40	,,	21	I	Oc D	4	29	,,
2	*I*	*Sh E*	5	39	,,	12	II	Tr E	9	25	,,	21	II	Ec R	8	16	9 P.M.
2	III	Oc D	10	58	,,	12	II	Sh E	10	34	,,	22	I	Tr I	1	48	A.M.
3	III	Ec R	3	52	46 A.M.	13	*I*	*Tr I*	5	36	A.M.	22	I	Sh I	2	35	,,
3	II	Oc D	10	10	P.M.	13	*I*	*Sh I*	6	11	,,	22	I	Tr E	4	8	,,
4	II	Ec R	1	46	28 A.M.	13	III	Sh I	6	25	P.M.	22	*I*	*Sh E*	4	54	,,
5	*I*	*Oc D*	6	32	,,	13	III	Tr E	7	35	,,	22	I	Oc D	10	56	P.M.
5	*II*	*Sh I*	5	4	P.M.	13	III	Sh E	10	0	,,	23	I	Ec R	2	0	23 A.M.
5	II	Tr E	7	8	,,	14	I	Oc D	2	43	A.M.	23	I	Tr I	8	15	P.M.
5	II	Sh E	7	58	,,	14	*I*	*Ec R*	5	36	48,,	23	I	Sh I	9	3	,,
6	I	Tr I	3	51	A.M.	14	*II*	*Ec R*	5	40	24 P.M.	23	I	Tr E	10	35	,,
6	I	Sh I	4	17	,,	14	I	Tr I	12	2	,,	23	I	Sh E	11	23	,,
6	*I*	*Tr E*	6	11	,,	14	I	Sh I	12	40	,,	24	I	Ec R	8	29	10,,
6	*I*	*Sh E*	6	36	,,	15	I	Tr E	2	22	A.M.	25	IV	Tr I	4	5	A.M.
6	III	Sh E	6	0	P.M.	15	I	Sh E	3	0	,,	25	*II*	*Oc D*	5	3	,,
6	I	Oc D	12	58	,,	15	I	Oc D	9	9	P.M.	25	*I*	*Sh E*	5	52	P.M.
7	I	Ec R	3	42	3 A.M.	15	I	Ec R	12	5	28,,	26	II	Tr I	11	10	,,
7	I	Tr I	10	17	P.M.	16	I	Tr I	6	29	,,	26	II	Sh I	12	52	,,
7	I	Sh I	10	45	,,	16	I	Sh I	7	9	,,	27	II	Tr E	2	4	A.M.
7	I	Tr E	12	37	,,	16	I	Tr E	8	49	,,	27	II	Sh E	3	47	,,
8	I	Sh E	1	5	A.M.	16	IV	Oc D	9	20	,,	27	III	Tr I	10	52	P.M.
8	*IV*	*Tr E*	5	49	P.M.	16	I	Sh E	9	28	,,	28	III	Sh I	2	24	A.M.
8	IV	Sh I	5	53	,,	17	IV	Oc R	1	48	A.M.	28	III	Tr E	2	26	,,
8	I	Oc D	7	24	,,	17	IV	Ec D	8	45	36,,	28	*II*	*Oc D*	6	13	P.M.
8	I	Ec R	10	10	42,,	17	*III*	*Oc D*	5	38	,,	28	II	Ec R	10	51	50,,
8	IV	Sh E	10	21	,,	17	I	Ec R	6	34	13 P.M.	29	I	Tr I	3	36	A.M.
9	II	Tr I	5	22	A.M.	18	II	Oc D	2	44	A.M.	29	*I*	*Sh I*	4	29	,,
9	*II*	*Sh I*	6	22	,,	19	II	Tr I	8	49	P.M.	29	I	Oc D	12	43	P.M.
9	*I*	*Sh I*	5	14	P.M.	19	II	Sh I	10	16	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance, R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Jupiter

Is still visible all night long, and continues to be the most brilliant and conspicuous object in the sky; the diminution of his angular diameter from 42·7″ on February 1st to 40·5″ by the 29th being quite imperceptible, save by refined measurement. He is, in every respect, admirably placed for the observer.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	8 0·2	21 10·5	11 13·9 p.m.
6	7 57·6	21 18·1	10 51·7 ,,
11	7 55·3	21 25·1	10 29·7 ,,
16	7 53·1	21 31·3	10 7·8 ,,
21	7 51·2	21 36·6	9 46·3 ,,
26	7 49·5	21 41·1	9 25·0 ,,

So that Jupiter, like Mars, is travelling backwards in Cancer; the path of Jupiter, however, commencing at a point just South of the 6·5th mag. Star μ² Cancri, and extending into the perfectly barren region between Cancer and Gemini.

Mercury

Is a morning Star during the entire Month, attaining his Greatest Elongation West of the Sun (26° 12′) at 5 a.m. on the 14th. His diameter decreases from 8·8″ on the 1st to 5·6″ by the 29th. He is but poorly placed for the observer.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	19 30·0	19 5·7	10 45·8 a.m.
6	19 36·4	19 48·3	10 32·5 ,,
11	19 51·9	20 6·7	10 25·3 ,,
16	20 13·4	19 56·4	10 30·0 ,,
21	20 38·6	19 15·0	10 35·5 ,,
26	21 6·2	18 1·4	10 43·4 ,,

Hence Mercury will be seen to travel from

Sagittarius into Capricornus; but through a region of the sky destitute of any conspicuous stars.

Venus

Is an Evening Star all through February, and her position in the sky is improving as far as the observer is concerned. Her diameter increases slowly from 12·5″ on February 1st to 14·2″ by the 29th, and she is markedly gibbous.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 3·8	7 26·0 S.	2 18·9 p.m.
6	23 26·2	4 53·1 ,,	2 21·6 ,,
11	23 48·3	2 17·2 ,,	2 24·1 ,,
16	0 10·2	0 20·3 N.	2 26·3 ,,
21	0 32·0	2 57·7 ,,	2 28·3 ,,
26	0 53·8	5 33·8 ,,	2 30·4 ,,

The path indicated by the above Ephemeris carries Venus from Aquarius through the blankest part of the Constellation Pisces.

Mars

Comes into Opposition to the Sun at 11 a.m. on February 1st. He is now visible all night long, and is as favourably placed for the Observer, as he will be for some considerable time. His disc subtends an angle of 16·6″ during the early part of the Month; but this diminishes to 14·5″ by the 29th. The reader must not expect the planet to present the same splendid appearance that he did during the memorable Opposition of 1877 (when his angular diameter was 29·4″); but he is still a very striking and interesting object in the telescope: the Polar Snow and the (supposed) "seas" which diversify his face being well seen with adequate optical power.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 2·8	21 36·1	12 16·3 p.m.
6	8 54·6	22 8·4	11 48·5 ,,
11	8 46·9	22 35·1	11 21·2 ,,
16	8 39·9	22 55·6	10 54·5 ,,
21	8 33·8	23 9·6	10 28·8 ,,
26	8 29·0	23 17·1	10 4·3 ,,

Thus Mars will start from a point in Cancer something like 1° South of the 5th Mag. Star ξ in that Constellation—through which he is travelling backwards. On the night of the 19th he will be a little more than 1½° North of γ Cancri.

Saturn

Is an Evening Star; but Southing as he does about 7h. 20m. p.m. on the 1st, and about half-past 5 o'clock at the end of February, is, of course, best seen during the earlier hours of the night. His diameter decreases imperceptibly from 17·2″ at the beginning to 16·4″ by the end of the Month. Little or no change is perceptible in the opening of his rings, and he still presents a beautiful and interesting spectacle to the young observer.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	4 6·1	19 2·6	7 20·5 p.m.
6	4 6·1	19 4·0	7 0·8 ,,
11	4 6·3	19 5·9	6 41·4 ,,
16	4 6·7	19 8·4	6 22·1 ,,
21	4 7·3	19 11·3	6 3·0 ,,
26	4 8·1	19 14·7	5 44·2 ,,

Hence Saturn, as seen with the naked eye, will remain sensibly stationary a little to the West of the 4·3 mag. Star ε Tauri—the Northernmost one in the Hyades.

Uranus

Rises just before 9 o'clock on February 1st, and, approximately, two hours sooner by the last day of the Month; so that he is now fairly visible by midnight. He presents a sensibly constant angular diameter of 4″, and exhibits a very apparent pale blue disc in the telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	11 53·0	1 36·6	3 10·1 a.m.
6	11 52·5	1 40·1	2 49·9 ,,
11	11 52·0	1 43·9	2 29·7 ,,
16	11 51·4	1 48·0	2 9·4 ,,
21	11 50·7	1 52·5	1 49·0 ,,
26	11 50·0	1 57·2	1 28·7 ,,

The short retrograde arc indicated by the above Ephemeris lies, roughly, about half-way between β and η Virginis.

Neptune

Is an Evening Star; but should be looked for during the beginning of the Night, as he is approaching the West, and by the End of the Month sets at Midnight. He is in quadrature with the Sun at 2 p.m. on the 7th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 5·3	15 35·3	6 19·8 p.m.
6	3 5·4	15 35·9	6 0·2 ,,
11	3 5·5	15 36·8	5 40·7 ,,
16	3 5·7	15 37·9	5 21·2 ,,
21	3 5·9	15 39·2	5 1·8 ,,
26	3 6·2	15 40·7	4 42·5 ,,

This very short arc is described in that perfectly blank region of the sky between 3° and 4° South of δ Arietis.

Shooting Stars

Are not common in February. The nights of the 10th and the 19th are those upon which their apparition is most probably to be expected.

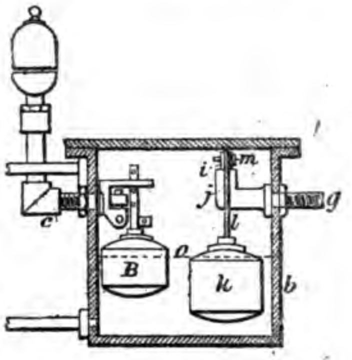
Greenwich Mean Time of Southing of Sixteen of the Principal Fixed Stars on the Night of February 1st, 1884.

Star.	Souths. h. m. s.
α Ceti	6 10 46·27 p.m.
α Persei	6 30 33·68 ,,
γ′ Eridani	7 7 1·27 ,,
Aldebaran	7 43 34·64 ,,
Capella	8 22 20·42 ,,
Rigel	8 23 9·97 ,,
α Leporis	8 41 46·02 ,,
α Columbæ	8 49 34·91 ,,
α Orionis	9 2 59·43 ,,
γ Geminorum	9 44 59·85 ,,
Sirius	9 53 59·74 ,,
Castor	10 41 2·23 ,,
Procyon	10 47 2·81 ,,
Pollux	10 52 1·48 ,,
β Cancri	11 23 56·53 ,,
α Hydræ	12 35 24·56 ,,

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in February, as also that of determining the Mean instant of its Transit at any other Station, will be found on p. 359 and 360 respectively.

SELF-ACTING BOILER FEED AND ALARM.

The annexed engraving represents a method of regulating the feed to steam boilers by a self-acting apparatus, recently patented by Mr. W. White, of Mansford-street, Hackney. As will be understood, the arrangement can be carried out in a variety of ways, and that illustrated combines in the same apparatus a self-acting low-water alarm in the shape of a whistle. The invention has for its object the regulation of the feed or supply of water into steam boilers by a self-regulating apparatus, so as always to keep the water in the boiler at one level so long as the injection pump acts, and thus make it impossible for a boiler to explode for want of water; and, further, as a safeguard against the pump failing to act, a whistle alarm is attached to a cylinder or other suitable chamber, at the lower part of which is an inlet to receive water from the boiler, and at the upper part of the chamber are an inlet and an outlet (*g*) for steam, by means of which steam is led into the pump or suction pipe. The pipe projects inside the chamber, and to the end of it is fixed a suitable valve and valve box, and in the lower part of the chamber is a float that will rise and fall as the water ebbs and flows. By means of two side rods and a cross bar the float is connected with the valve in the valve box, so that the valve will rise up and lower down with the float as the water ebbs and flows in the chamber and boiler, the effect of which is as soon as the water is pumped into the chamber to the right level the float will open the valve and allow steam to pass through the chamber and pipe *g* into the pump or suction pipe, and prevent the pump from throwing any more water until the valve is again closed, and by this means neither can too much water be got into the boilers nor will the water be allowed to fall below its proper level, it being perfectly self-acting, without the interference of any workman. And, further, in the event of the pump ceasing to act, for the purpose of giving an alarm, a whistle placed either on the boiler or on the chamber is worked by a valve and float, which acts in the same manner as the apparatus for regulating the feed.



In the illustration, a separate float B is shown as actuating the steam whistle, steam being admitted by the pipe *c*; *k* is a float connected by a bow, *l*, to a valve, *i*, working in a box, *j*; the head of the bow being secured to the valve by the pin *m*; *o* shows the water line, and *b* is the chamber or cylinder in which the apparatus is arranged. In the position shown the upper part of the cylinder is filled with steam, the chamber having open communication with the boiler, and all other outlets closed. If, now, the feed pump throws more water than is required, the level will rise and lift up the float *k*, which, in turn, will open the valve *i*, through which steam will rush to the pump through pipe *g* and stop its working. Similarly, if the water falls below the normal level, either in consequence of the pump stopping or failing to throw sufficient water, the float *b* will fall, and allow steam to pass through pipe *e* to the whistle, thus calling the attention of those in charge of the boiler.

PROTECTING COATING FOR IRON AND STEEL.

A method of giving articles of iron and steel a protecting coat of rust has been patented in this country on behalf of Mr. E. Nicolaus, of Lauchammer, Saxony. According to the patentee the new or improved process combines the covering power of oil paint with the fineness of a galvanic covering and possesses an extraordinary durability. The objects are thereby altered chemically at their surfaces only, and there is thus in reality no separate coating. The process can be applied with equal safety to cast iron, wrought iron, or steel. The objects to be patinaed are first carefully ground and polished in order to produce a clean metallic surface, to remove dirt, and to prepare it to receive the lustre or brilliancy required in some cases for the complete effect; then follows the most important manipulation—namely, the annealing of the objects. Cast iron, especially such as is very thin, for artistic and architectural purposes, by reason of its unequal thickness cannot be subjected to the process unless annealed. The annealing of the cast objects is intended to make the material homogeneous, whereby the success of the succeeding operations is secured. So-called tempered cast articles must likewise be subjected to the annealing process: larger objects, such as statues or monumental castings, can be subjected to the succeeding operations without further preparation, as their material possesses sufficient homogeneity. When the articles are regularly annealed they are allowed to cool slowly, and are then placed in a pickle to remove the annealing scale. This pickle may consist of a weak solution of sulphuric or muriatic acid in which the article is immersed for a few minutes: then follows a mechanical working of the surface by scouring in order to remove the scale completely. When the object is completely cleansed, so that all uneven parts and annealing scales are removed, the peculiar patinaing process can be commenced. This process consists in so laying on a dilute inorganic acid (about one part of acid to five parts of water) that the surface is covered with a very thin coating of the liquid. After covering over with this rust-water the object is allowed to dry completely, and it is then brushed or rubbed with clean rags, after which the rusting process is repeated in the same manner as before, and the remainder of the rust which is not fixed is removed after the subsequent drying by means of brushes and rags.

Finally, the previously warmed cast article is painted over with linseed oil, it is then dried in an oven or drying room, and is then covered with colourless lacquer (*spiritus lac*), which can be made highly brilliant at any required parts by wax polishing. Castings treated in this manner become of a beautiful durable black colour when submitted to the action of heat in a stove. For browning wrought iron and steel the above described process gives better results than the ordinary process, and has the advantage of greater simplicity. In treating wrought iron and steel the annealing process is dispensed with, because those materials already possess the homogeneity requisite for the patinaing process.

ON A NEW CAMERA LUCIDA.*

By Dr. Hugo Schröder.

In the recent volumes of the *Journal* of this Society I have met with descriptions and figures of several forms of camera lucida which were new to me. I obtained an example of each, and made a series of trials in comparison with the older forms with which I was already familiar. In all of them I found more or less defects, such as limitation of field, distortion, indistinctness of image or of drawing-point, awkwardness of position, &c. Being engaged later in endeavouring to simplify and perfect the construction and adjustment of Mr. Wenham's high-power binocular prism, I was much interested by the ingenuity of this device, and it occurred to me that that arrangement of prisms might be modified, so as to be available as a camera lucida in which the defects of the forms hitherto made would be considerably reduced if not entirely eliminated.

Assuming a 45° inclination of the microscope to be the position most generally convenient for drawing, I (in June last) drew on a large scale the system of prisms which appeared to be suitable for a camera lucida. Messrs. Ross undertook to construct the prisms to my drawings, and the apparatus was found upon trial to answer my expectations fully. I am induced to describe it here because it has also met with much approbation from microscopists, who were previously disinclined to believe in the possibility of any new device at the present day, which should be substantially better than the numerous older forms which apparently exhausted the subject.

It is well known that all forms of reflecting prisms acting by means of *one* reflection are extremely sensitive in regard to the position of the mirror in relation to the microscope, as also in a less degree in relation to the eye: the slightest deviation from the normal position in many cases entirely destroying the effectiveness of the apparatus. For this reason cameræ lucidæ acting by *one* reflection have not found favour, though their apparent simplicity has induced the construction of many such forms.

In order to obviate the difficulties incident to the use of *one* reflection, many devices have been made acting by *two* reflections, and where these have been so contrived as to act like parallel mirrors, the reflected image has *possessed* the advantage peculiar to this principle, of being practically insensitive to slight differences of position relative to the microscope or to the eye, remaining in fact stationary within a considerable range of adjustment, as in Wollaston's camera lucida.

FIG. 1.

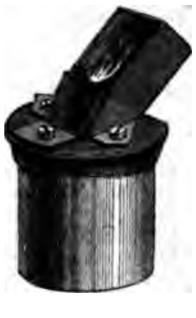
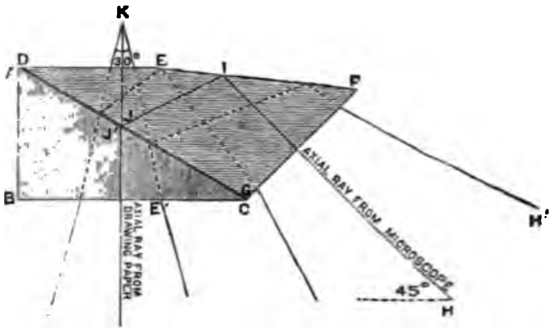


FIG. 2.



My device (Fig. 1) consists of a combination of a right-angled prism (Fig. 2), A B C, and a rhomboidal prism D E F G, so arranged that when adjusted very nearly in contact (i.e. separated by only a thin stratum of air) the faces B C and D E are parallel, and consequently between D E and B E' they act together as a thick parallel plate of glass through which the drawing-paper is viewed. The rhomboidal prism is so constructed that when the face G F is applied at right angles to the optic axis of the microscope, the axial ray H passes without refraction to I on the internal face E F, whence it is *totally* reflected to J in the face D G. At J a part of the ray is reflected to the eye by *ordinary* reflection in the direction J K, and a part transmitted to J' on the face A C of the right-angled prism. Of the latter a portion is also reflected to K by ordinary reflection at J'. The hypothenuse face A C is cut at such an angle that the reflection from J' coincides with that from J at the eye-point K, thus utilising the secondary reflection to strengthen the luminousness of the image. The angle at G is arranged so that the extreme marginal ray H' from the field of the B eyepiece strikes upon D G at a point just beyond the angle of total reflection, the diffraction-bands at the limiting angle being faintly discernible at this edge of the field. This angle gives the greatest amount of light by *ordinary* reflection short of *total* reflection.

By this arrangement the Ramsden circle over the eyepiece comes just above the camera lucida, and the field of view is not in any way reduced; all that can be seen directly through the B eyepiece (say 30° of field) is perfectly depicted in the camera lucida, whilst the drawing being viewed direct is of course not cut down in field.

In practice the microscope should be inclined about 45°, and the image accurately focused through the eyepiece as usual. The camera is then slid on the eyepiece and pushed down more or less until the microscopical image is seen distinctly and the illumination of the field is equal throughout. The drawing-paper is placed on the table immediately under the camera. The observer will then see the microscopical image projected on the paper, at the same time viewing the pencil-point directly. The *whole* pupil of the eye is available for both images, the diaphragm on the apparatus being considerably larger than the pupil. It may be necessary to balance the illumination either by subduing the light in the microscope or by increasing it on the drawing-paper. It will generally be found that when the object is in a luminous field the light on the object (especially with lamplight) may be advantageously subdued by ground glass or similar means. The eye may be removed as often as required from the camera, and the work recommenced without the slightest shifting of the image; and with properly balanced illumination, fully shaded drawings can be made with very little practice. The drawing-paper should in every case be placed at the distance of distinct vision, either using spectacles or not. If the vertical position of the microscope be preferred, the drawing-paper may be inclined 45°, either in front or at the side of the instrument. For very accurate drawings in all azimuths, the drawing-paper should of course wholly coincide with the plane of the optical image, as with every other form of camera lucida. A spring clip is provided in which a screen of black paper may be put to shade the eye not in use.

This form of camera lucida can be modified so as to project the image at any desired angle. It can be used with the dissecting microscope or hand-magnifier, also on a stand for architectural or mechanical drawings.

THE HISTORY OF A BUCKET.

In an interesting paper on the history of a bucket, recently read before the Warrington Literary and Philosophical Society, Mr. T. Morris said:—There is not the slightest doubt about the sheet iron being manufactured in South Staffordshire from which the first bucket was made, and this will be my reason for describing the treatment and passage of these ores from the stone to the very useful domestic article under consideration. The first step taken after the clay iron ore is brought out of the pit is to make it up into heaps with roughly-built sides; in this form it lies for a time to weather, the action of the sun and rain causing a large amount of adhering useless matter to fall from it. It is afterwards calcined, a process technically called "roasting." This consists in the application of a moderate heat, whereby the more volatile components of the ore, such as carbonic acid, sulphur, &c., are expelled. This is effected by spreading on the ground a stratum of coals to a depth of about eight inches, over which is laid a layer of ironstone to a depth of about 6ft., interspersed with small cinders and coke dust and covered with small coals. The coals being set on fire combustion will go on for nearly a month, when the cementation is complete. The modern method of performing this roasting process is in a kiln, the coal and ironstones being put in at the top, and the roasted ore taken out at the bottom. The next operation is the conversion of the calcined ore into metal by the application of a white heat in a furnace. This process is called smelting. As will be readily understood after what we have said on ores of iron, after the roasting process they consist of an oxide of the metal, combined with some earthy matter in very various proportions. If these ores were fused alone, anyone having the least knowledge of chemistry will at once perceive that they would be formed into glasses, the properties of which will vary with the composition of the ore, but retain no metallic character. The method of proceeding, therefore, must be to intermix the ironstones with such substances as during the process of fusion will combine with the oxygen and earthy matter of the ore and leave the metal free. The early metallurgists knew no fuel but charcoal, but this was fast getting exhausted when Lord Dudley, of South Staffordshire, in the year 1650, or about that time, got letters patent to use pit coal. Ever since then the ordinary coal when converted into coke has been found to be the most useful and economic fuel. From the great affinity of this coke or carbon for oxygen, it is selected as the proper substance for separating the metallic base from the oxygen. The nature of the other substances to be employed i separating the earthy matter of the ore is deter mined by the species to which that earthy matt belongs. In the case before us limestones are use they being the best flux to form glasses or slag with the earthy matter of this argillaceous ore. T give the construction of a smelting furnace will b out of place. It will be sufficient to say that th ores, coke, and flux are charged into the top and a acted upon by the heat rising up from the low part of the furnace, the combustion being acce erated by air being blown into the furnace und pressure. The oxygen of the ore combines with th carbon of the coke, the limestones with the alumin silica, &c., and a portion of the carbon with th metal, which being the heaviest falls down to th lowest part of the furnace. There are suitab openings in the lower part of the furnace, one at th bottom of the hearth which is opened at fix periods to allow the molten iron to run out, and o at the top of the hearth or "bosh," as it is calle from which the slags are continually flowin Whilst this lowest part of the furnace is filling wi iron by the fusion of the ores the men are engag in making rough moulds in sand to receive th metal, which when cast is commonly known as p iron; by metallurgists it is called the carburet of iro Thus what it took nature myriads of years to form converted in a few hours by the knowledge a handiwork of men into the most useful met known. It is the finished and sheet iron maker th we have now to do with. For a few minutes w will follow him and see what he does with th useful metal. It is of no moment to describe th puddling furnace, only to say that this is the fir stage the finished iron maker passes it through, a that the furnace has two compartments, one calle the grate and the other the hearth, the two bein divided by a bridge composed of iron plates, wi firebrick on that side of them next the fuel part, a on the other side where the metal is put a lining (fettling) of a refractory material, the latter bein blackband ironstone after being calcined, or sa

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* Journal Royal Microscopical Society.

It was well enough for observers of past generations to describe colours superficially: but spectrum analysis has shown us that we may gain as perfect a knowledge of the chemical constitutions of stars as a chemist can of the identity of a metallic salt on his laboratory table.

The Chairman said he thought Professor Smyth had attached too much importance to what was, after all, but the expression of opinion from an individual member. The Society was glad to encourage observational astronomy, and to publish the results of such observations; but they ought not to be held responsible for errors that might be contained in those observations. With regard to tracing the colours of stars up to their places in the spectrum, that might hereafter be done; but at present it was impossible, as the amount of work entailed on the management was enormous. The suggestion had, however, reminded him that Dr. Huggins had kindly presented the Society with a complete series of his works, and had expressed his sympathy with the objects of, what he was pleased to term, "the infant Hercules."

Mr. Espin then read a paper "On a New Theory of the Cause of Stellar Variation." The star [illegible] Pegasi is a known binary. At the time of its discovery, the components were a second of arc apart; but in 1866 it was observed to be single by Secchi, since which time it has widened, being half a second apart in 1875, and was observed by myself as strongly elongated, if not divided in Oct., 1880. Mr. Pocklington, while observing stars, at my request, in this region, found the magnitude as 5·3. Now in the *Uranometria Argentina*, it is classed as 5·5, and yet in the two neighbouring stars, 34 and 35 Pegasi, Mr. Pocklington's estimate agrees exactly with Dr. Gould's. This result was so very curious that I measured it with the photometer on Dec. 6, 1883, and the resulting magnitude came out as [illegible]·4. It at once suggested itself to me that the variation in light might be due to the closing and widening of the two stars, and I believe this may account for the long periods of fluctuation in many stars: if so, we have a new method of determining which are binary stars without the use of the telescope.

A paper by Mr. W. F. Denning, F.R.A.S., was read on the "Meteors of February [illegible]":—During the night of February [illegible], 1877, I observed two well-defined meteoric showers from the points.

R.A. [illegible] Dec. 24 N.
R.A. [illegible] Dec. [illegible] N.

The meteors were rather bright and moved in swift courses. I am desirous of calling attention to those shown, in the hope that they may be re-observed during the present year. As to the former shower, it appears to have been seen by several observers, as follow:

	R.A.	Dec.	
Jan. 1-25.	[illegible]	[illegible]	Greg and Herschel.
Jan. 4-11.	[illegible]	[illegible]	Tupman.
Feb. 2-10.	[illegible]	[illegible]	Tupman.
Feb. 6.	[illegible]	[illegible]	Schiaparelli and Zezioli.
Jan. Mar. [illegible]	[illegible]	[illegible]	Meteor Cat. [illegible]

It is obviously one of those radiants which, though of long endurance, yet display special activity on certain nights.

Mr. E. F. Sawyer, Cambridgeport, sent an interesting account of the occultation of [illegible] Libræ. When the star had reached the dark edge, its sudden disappearance was looked for; but the star apparently projected itself on the dark limb of the moon until it had very nearly advanced inside the dark edge.

Papers were read by Mr. W. S. Franks, F.R.A.S., Mr. W. [illegible], and others, and the meeting adjourned at [illegible].

Cinchona Bark.—In the year 1882 the imports into the United Kingdom amounted to [illegible], against [illegible] in the previous year. The total value of the imports for 1882, although upwards of [illegible] more were imported, shows a diminution of [illegible]. Of the different countries where the bark is cultivated, Ceylon is by far the most important, but it is said that Bolivia, Java, and Southern India are making great efforts in the same direction. As an easy classification of the barks produced in the different regions of South America, Mr. Hamilton suggests the following:—(1) Officinalis (crown bark, or "[illegible]" bark), as it is classified in [illegible], rich in quinine; [illegible] cinchonidine, or "red" bark, rich in cinchonidine; [illegible] Columbian barks, comprising [illegible] lancifolia, and Carthagena [illegible], both rich in quinine and [illegible] Pitayo, rich in quinidine and [illegible], although not a true cinchona, contains quinine, quinidine, cinchonidine, and the new alkaloid [illegible] in some cases. (4) [illegible] and (5) [illegible], rich in cinchonidine, and (6) Calisaya [illegible] bark, very rich in quinine and [illegible] cinchonidine.

SCIENTIFIC NEWS.

THE most noticeable feature in connection with the Comet Pons-Brooks at present recorded is the remarkable change in brightness which it appears to undergo now and then. Dr. Müller, of Potsdam, reports another sudden increase of brightness on January 1st, for at one observation he made on that day the nucleus was large and diffused, the brightness agreeing well with the calculated light-curve. Two hours afterwards, instead of a diffused nucleus he found an almost stellar point, equal in brightness to a seventh mag. star. Two hours later the comet had recovered its normal appearance. The time would be between 7 and 9 G.M.T., Jan. 1, and it would be interesting to learn whether the change was noticed by other observers.

At a recent meeting of the Physical section of the Royal Dublin Society, Mr. Howard Grubb, F.R.S., read a paper on a "New Form of Equatorial Telescope," in which the observer is placed under more favourable conditions—in fact he may be as comfortable as the microscopist. He described some forms of instruments of a small size which he had constructed, and then showed on the screen by means of a lantern a design for a colossal instrument, in which all the optical and large mechanical parts were in the open air, except the eyepiece, which was situated in a room on the top story of a house. The observer was represented seated in an easy chair, beside which were two handles controlling hydraulic machinery by which all the movements of the great telescope were effected. The French have accomplished something of the kind with their bent, or elbow, equatorial, but at enormous cost and much complexity; whereas Mr. Grubb's device can, it appears, be produced for about one-third the price of the usual form.

The Rev. Dr. Haughton, F.R.S., read a paper the other night before the Royal Geological Society of Dublin, on the remarkable sunrises and sunsets. So far from accepting the volcanic dust hypothesis, Dr. Haughton contends that the phenomena were merely intensifications of the ordinary phenomena of twilight, and did not point to exceptional reflecting powers in the atmosphere.

Mr. N. E. Green, F.R.A.S., lecturing at Ealing last week, adopted the volcanic dust hypothesis, as he found the others untenable; the meteoric dust theory being negatived by the fact that the sunsets occurred before Biela's comet was due. Mr. Green said if dust from the Java volcano really got to the upper regions of the atmosphere, which was less attached by gravity to our earth, it might come into a stratum of air lagging behind those nearer the earth, and thus its slow arrival from the east would be accounted for.

At a meeting of the Royal Society of Edinburgh, Mr. John Aitken read a paper on "The Dark Plane in Dusty Air," in which he said that the downward dark plane was caused by the separating action of gravitation, but that the tops and sides of cold bodies had no dust free spaces surrounding them; while the upward dark plane was produced by gravitation, by repulsion due to heat, and by evaporation and disintegration. By an application of electricity it was demonstrated how air was purified, the entire dust of the air being deposited on the sides of the vessel in which the experiment was made. A question of great interest was, how did the lungs keep working, considering the enormous quantity of dust in the air? The experiments he had made went to prove that the heat of the lungs tended to repel and to evaporate the dust particles, and thus keep the lung surface free from the contamination of dust. The tendency which dust had to leave hot surfaces and settle upon cold ones had suggested to him the possibility of making an air filter on thermic principles. Referring subsequently to the sunsets, Mr. Aitken thought that the blues and greens which had been seen at the same time as the reds, proved that the rays of light had been reflected by dust, and for that reason he thought the remarkable sunsets were caused by dust, and not by aqueous vapour.

Our readers will be sorry to hear that Mr. John Brown, of Belfast, while experimenting in the chemical laboratory of Trinity College, Dublin, was severely injured by an exploding retort. A piece of glass entered one of his eyes, and the surgeons have unfortunately found it necessary to remove that organ.

The Gresham Lectures on Astronomy will be delivered in Gresham College, Basinghall-street, at 6 p.m., on Feb. [illegible] and [illegible]. The subjects will be the planet Saturn, Comet Pons-Brooks, the recent Sunrise and Sunset Phenomena, Circumpolar Constellations, the Dragon, Cassiopeia, &c.

Dr. Angus Smith's next report to the Local Government Board, as one of the Inspectors under the Rivers Pollution Prevention Act, will contain matter which will be regarded as highly important by all who take an interest in microbiology in general, and in the germ theory of disease in particular. Dr. Smith's recent researches have led to the discovery that in all natural waters sugar ferments and hydrogen gas is given off. The proportion of hydrogen given off varies with the organic impurity of the water, from the mountain stream to the worst sewage, so that the proportion of hydrogen evolved appears likely to prove a quantitative test of the activity or virulence of the microbes present in the water.

Mr. E. A. Cowper's lecture on the "Steam-engine," one of the series on "Heat in its Mechanical Applications," delivered before the Institution of Civil Engineers, was illustrated by an interesting collection of models and drawings, showing the progress of the steam-engine from the earliest Newcomen 1711 down to the monster marine engines of the present day.

At the last meeting of the Chesterfield and Derbyshire Institute of Engineers, the adjourned discussion of a paper on the "Principles of Electric Lighting and Transmission of Power by Electricity" was taken. The author of the paper stated that Derbyshire was behind every other district with regard to electric lighting, but was promptly informed by Mr. Stokes, inspector of mines, and others, that the mining engineers of Derbyshire were the very first to experiment with it—and condemn it. If they could have electricity in a vessel that could be carried about it might answer; but wires in a pit had failed.

According to Sir W. Thomson, the Lalande-Chaperon cell is inferior to the Bennett in E.M.F., but is superior to every other form with which he is acquainted in its remarkable capacity for giving strong and steady currents from plates of moderate area. The Lalande-Chaperon cell was illustrated and described on p. [illegible], Vol. XXXVII.

A pupil of the late Prof. Rolleston, at Oxford, has been chosen to succeed the late Mr. W. A. Forbes, as prosector to the Zoological Society of London. Mr. Frank E. Beddard has been employed on editorial and other work connected with the reports of the *Challenger* expedition, and has been intrusted with the examination and description of the Isopoda collected during the voyage.

M. Bouley has been appointed vice-president of the Académie des Sciences of Paris. As the natural consequence he will become president in 1885.

The *Guardian*, discussing the resistance of disease germs to disinfectants, remarks that it is extremely probable that the disease germ of small-pox is present in the form of living bacilli in the fluid which is the principal bearer of the infection—the lymph removed from the pustules. The degree of vitality of the bacilli varies in the different kinds of lymph, the lymph from cow-pox losing its capacity for infection much more readily than the so-called human lymph.

On Wednesday evening, our contributor, Mr. W. J. Lancaster, delivered a lecture on the "Political History of Birmingham," illustrated by specially-prepared lime-light views, before the "Forward" Liberal Club at Birmingham.

As wood changes under the influence of the air, growing brown and consequently diminishing the durability of the paper in which it has been employed, it is of importance, for the dealer and consumer, to be able to ascertain whether a given sample of paper contains woody fibres or not. For this purpose a solution of sulphate of aniline, or a mixture of one part sulphuric acid, three parts nitric acid may be employed. Either of these solutions produces immediately a yellow colour upon the paper if it contains wood, the depth of the shade increasing as the proportion of wood increases.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE NEW COUNCIL LIST OF THE ROYAL ASTRONOMICAL SOCIETY—VOL. XLVII. OF THE R.A.S. "MEMOIRS" — MARS, JUPITER, AND SATURN — TELESCOPES OF LONG FOCUS — ANEROID BAROMETER — "FAME'S PENNY TRUMPET"—CITY GUILDS AND BROMPTON GRASPING — INCHES v. CENTIMETRES — RED STARS AND AN UNREADY REWARD —BLUE MOONS—SUNRISE AT THE CLUN STONE CIRCLE — CALCULATION OF COMETARY ORBITS.

[22289.]—In common, of course, with every Fellow of the Royal Astronomical Society, I have just received the "House-List" of the Officers and Council of the Society for the ensuing year. It is simply a repetition of the old story—by a shuffling of the cards between the Vice-Presidents and the ordinary Members of Council, substantially the current list of office-holders reappears. One new name, however, will certainly be welcomed by the Fellows: it is that of that thorough astronomer and single-hearted man of science, Colonel Tupman, who is nominated as one of the secretaries. I can only express a hope that one or two of the paltry traders upon science with whom Colonel Tupman will sit will appreciate the honour done them by association with the man, whose disinterested zeal for the promotion of astronomy prompted him to carry on the Computations of the 1874 Transit of Venus at his own cost, after the allowance from the Treasury had ceased. I am most sincerely sorry, though not surprised, to note the disappearance of Mr. Barrow's name from the office of treasurer. Of course the reason is not far to seek. He does not dine with the wire-pullers in the council who aid and abet the South Kensington ring, and so, of course, had to be got rid of. On the whole, though, I have seen worse lists, and if voters will only run their pens through the names of actual members of that most paltry imposture, "The Committee on Solar Physics," substituting for them those of such well known and independent men as Mr. G. F. Chambers, Sir James Cockle, Sir Edmund Beckett, Mr. Franks, or Mr. Green, I do not think that the interests of astronomy, as contradistinguished from those of certain persons, will be likely to suffer at the hands of our new executive.

Apropos of the Royal Astronomical Society, the volume of its *Memoirs* (XLVII.) just issued contains much that is of interest to the astronomical student. To begin with: no one can, I think, read the detailed accounts of the various observations of the last Transit of Venus without being forcibly impressed with the idea of their untrustworthy character as a means of determining the Solar Parallax with anything like rigid accuracy. It is quite extraordinary to read of the different aspects presented by the same phenomenon to men observing almost side by side. Some appear to have seen nothing whatever in the shape of the notorious "black-drop"; others to have observed it in its most aggravated form: while in at least one case, so far from a ligament connecting the planet's limb with the dark sky beyond that of the Sun, the limb of Venus appeared at egress actually to push, as it were, the bright limb of the Sun before hers! Any attempt to collate the times of occurrence of the various phases described in such extraordinarily diverse terms must, it would seem, be almost futile. In fact, it can only be by an ingenious process of "cooking" that they can be rendered susceptible of comparison at all. Passing from this subject, I need merely give the title of a paper by Mr. S. W. Burnham ("Double Star Observations made in 1879 and 1880 with the 18½in. refractor of the Dearborn Observatory, Chicago, U.S."), to indicate its high interest and value to every one engaged in the study of the stellar heavens. Mr. Plummer, of the Oxford Observatory, has been reinvestigating the question of the solar motion in space, from a discussion based upon the proper motions of stars in the Southern hemisphere. A similar discussion was undertaken by Mr. Galloway about 40 years ago; but Mr. Plummer has employed the improved and more accurate proper motions given in Mr. Stone's admirable "Cape Catalogue." He comes to two conclusions worthy of note: the first being that it appears probable that, *on the whole*, proper motion is a measure of stellar distance; and next, that the direction of the solar motion in space is towards a point in the heavens situated in R. A. 18h. 24m. 32s., and declination 26° 31′ North. This is in a very blank region of Hercules S. by W. of Vega. Mr. Dunkin, it will be remembered, from a discussion of all the most trustworthy results since the time of Sir Wm. Herschel, placed the apex of the solar motion in R.A. 17h. 34m. 56s., and declination 25° 0·5′ north; a little to the S.E. of λ Herculis. And last, though by no means least, I must mention two papers by Professor Pritchard, one on the "Measurement of Lunar Photographs"; the second on the "Photometry of the Brighter Stars North of the Equator." I have spoken formerly in such very definite terms in these columns of Doctor Pritchard's connection with the miserable XLth Volume of our *Memoirs*, that I shall assuredly not be suspected of being prompted by any feeling of private friendship or wish to flatter the Savilian Professor when I say that both these papers—and notably the latter—are of great and enduring interest and value, and give the results of an enormous amount of real hard scientific work. The remaining paper in the volume is one by Mr. H. C. Russell, the Government Astronomer of Sydney, who has been remeasuring Herschel's Cape Stars. Its use will be chiefly confined to observers in the Southern Hemisphere.

If evidence were needed of the care and accuracy of the observations of "M.A.," it would be found in his letter (22239) on p. 427. As far as my own experience goes, his description of the telescopic aspect of Jupiter and Saturn is rigidly accurate. The "fine mist" of which he speaks is certainly essential for the finest definition of Jovian detail. By far the best drawings I have ever made of Jupiter in my life have been made when a faint haze overspread the sky. Under such conditions the colouring of the planetary markings becomes wonderfully accentuated: the general glare of Jupiter's surface, so to speak, diluting it, under normal circumstances. The tints of the ball and rings respectively of Saturn, which "M.A." describes, are identically those which I see myself. In connection with Mars, I can only repeat what I said in letter 22097 (p. 301)—viz., that I have had splendid views of Areographic detail with a higher power than I can, generally, employ on Jupiter. I do not know, though, that the *limb* of the planet was particularly sharp.

With reference to query 52725 (p. 437), I would point out to Mr. Mee that, inter alia, the degradation of light by the increase of magnifying power is a very operative factor indeed in limiting the amount of amplification. Let us take his own hypothetical telescope of 2in. in aperture and of 30in. focal length, then, as he says, with an eyepiece of ¼in. focus, the linear magnifying power will be 120. Now, the aperture of the object-glass and the eyepiece remaining the same, let us double the focal length of the former, and we shall, in the result, get a power of 240. But the image (say, for the purpose of illustration, of Jupiter) formed in the focus of the objective will be of twice the diameter of that projected by the object-glass—of the same diameter—when its focus was only 30in., and hence will only be one quarter as bright as it was with the shorter-focussed glass. Double the increased focus, in other words, substitute a 2in. object-glass of four times the original focus, or 120in., and we degrade the light of any given part of the resulting image to the $\frac{1}{16}$th of that of the original one, and so on. Of course, the ultimate total loss of light of image, when it reaches the eye, is compounded of that which it jointly sustains from both the object-glass and the eyepiece. An extremely long focussed object-glass gives a large and very dim image for the microscope which we call the eyepiece to magnify; an objective of short focus, a smaller and brighter one; although this involves increased loss of light and greater aberration from the necessarily small lenses, with their deep curves, of the ocular. A great art of the practical optician is so to proportion these two elements as to afford the best result.

"C. J. N." (query 52741, p. 437) should by all means send his aneroid barometer to a practical philosophical instrument-maker for repair, and not even to a jobbing jeweller, who sells spectacles, &c., and calls himself an "optician." A good aneroid is far too delicate a piece of mechanism to be tinkered with by an amateur, or, in fact, by any-one but a skilled workman.

I hope that everyone to whom the honour and purity of science are dear will get the collection of poems by that inimitable humourist, Mr. "Lewis Carroll" (over whose "Alice in Wonderland" and "Through the Looking-glass," so many hundreds of thousands of us have laughed), if it be only for the sake of the one entitled "Fame's Penny Trumpet." The appositeness of the reference in one of the verses to a certain pictorial advertisement which was recently "got into" *Punch*, will strike the reader at once; while the scathing denunciation of the quacks and humbugs, whose slimy flattery of each other has no other object than the deception of the public and the filling of the pockets of their Mutual Admiration Society (Limited), must commend itself to every honest man. Mr. Lewis Carroll has never done a greater public service than he has in showing up the scheming and mendicant Cabal, whose partial success even, speaks but poorly for the state of popular knowledge in this country; and who, if scientific information were a little more widely diffused among the governing classes, would either have to transfer their cadging tactics to some other clime, or work honestly for their living here, like other people.

It is to be hoped that every one of the Civic Companies which have so lavishly contributed to the funds of the City and Guilds of London Institute, will read, mark, learn, and inwardly digest, the "Report of Sub-Committee A to the Executive Committee on the Organisation of the Central Institution," which was presented on January 21st of the present year. They will learn from it, now it is too late, how effectually they have handed themselves over to the domination of the South Kensington ring. At the time of the inception of the whole scheme efforts were made by certain members of the committee, representing those who actually provided the funds, to have the buildings of the Central Institute erected on some portion of the Victoria Embankment. It was known to (but suppressed by) at least one member of the committee that ample land for the purpose could have been obtained in the neighbourhood of the Savoy; but it was felt that the establishment of the headquarters in such a locality would have thrown too much power into the hands of the men whose sole function was to find the money, and who had already shown too much independence of the Brompton clique by appointing Mr. Magnus as organising director and secretary instead of Mr. Redgrave. Heaven and earth were therefore moved to get the collegiate buildings of the Central Institution erected at South Kensington; the "genteel" element was paraded in force, the snobbish instincts of such as could be worked upon were freely appealed to, and all the notorious sickening trade cant and "Albert-the-Good" business employed without stint. In the result, the representatives of the Guilds proper surrendered themselves to the astute schemers who had worked throughout in the sole interest of South Kensington, and it was decided to erect the Central College within the charmed area owned by the Commissioners of the Exhibition of 1851. It needs no supernatural intuition to discern in the Report now lying before me, the hand of some very active members indeed of the Brompton ring. After reciting the general objects for which the Institute was established, and enumerating the various professorships which it will be necessary to establish, this instructive document goes on (on p. 17) to treat of "Management"; and here we find that "2. Any lecturer holding an annual appointment, and giving a separate course of instruction, may be appointed by Sub-committee A as a member of the Board." The meaning of this is almost too obvious to need pointing out. Merely as a matter of course, this is a device for adding to the power of the ruling clique in the Direction. These professors must, under existing circumstances be, one and all, the creatures of South Kensington; and their votes will, of course, be used to crush the independent minority, who still weakly think that, because they merely represent those who are paying for the whole thing, that, hence, they have some right to a voice in the employment of the money! It is perhaps, though, in connection with such employment that this precious report is most noteworthy. Turning to p. 19 of it, I find that "For the efficient carrying out of the above scheme, it is believed that a sum of £15,000 a year will be required, part of which would be provided by the students' fees." This amount is made up as follows:—

Salaries of Professors, Lecturers, and Demonstrators	£8,700
Apparatus and Material	1,500
Clerks, Porters, Attendants, Servants, &c.	1,500
Printing, Advertising, Stationery, &c.	1,300
Repairs, Rates, Coals, Gas, Insurance, &c.	2,000
	£15,000

Deducting £5,000 as estimated fees from students, this leaves £10,000 to be provided for; and, assuming that the current expenditure (as a whole) for 1884 does not exceed £18,500, this, with the present annual receipts, would only leave an available balance of £6,000 for the Central Institute, so that there would remain at least £4,000 to be provided for. Now I hear, in a very roundabout, but, I am satisfied, perfectly trustworthy, way that, at the Committee meeting at which this report was pre-narrow stripes, whereof each alternate one retards light half a wave-length more than its neighbours, the spectra are *fourfold in brightness*. Now these also would still image lines, though falsely. The application to transparent microscopic objects need not be pointed out.

Yet the more we understand the true relations of these spectra, and their optical effects, the truer will our interpretations become, within, at least the limits of microscopic vision, and the more certainly shall we be directed to methods of manipulation which may truly interpret the phenomena. Taking merely the theory of the matter, let us consider the case of Fig. 2, where only the lines A A and B B really exist, but C C are apparent by the illusory spectra of the narrow spaces between A B, A B. It is plain we have means, if our suspicion as to the existence of C C C is awakened, of clearing it up For we can stop off not only the central pencil, but those inner spectra which give us the coarsest intervals A A A. This will bring into stronger relief the spectra representing the next widest spaces, B A, B A, and thus we may correct the former result. Also it is obvious that any skilful manipulator with a knowledge of physical optics, by stopping off central pencils, and, when necessary, inner spectra, might bring into stronger relief the much fainter spectra caused by fainter and finer striations, which were before "drowned," as it were, in the coarser phenomena. Mr. Stephenson proved this in the case of *P. angulatum*, bringing out minute patterns, when the central pencil was stopped off, which had never before been seen.

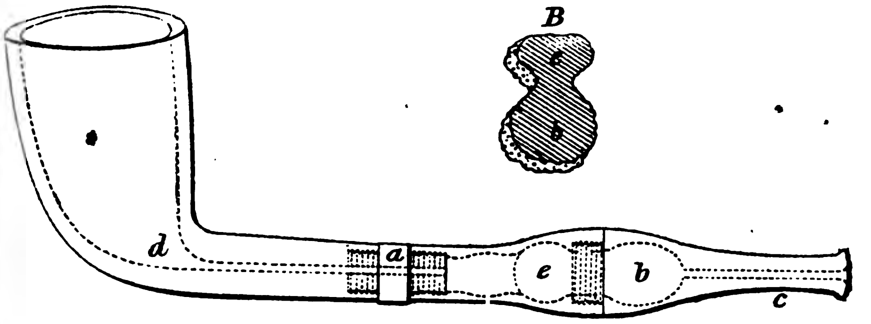
It is also evident why so much is learnt from various incidence of the light; but it will also appear that this should be studied more gradually than most mirror arrangements permit. As a rule, I see microscopists adjust for one obliquity, and make their observation; then try another. It would rather appear that continuous observation under a steadily increased obliquity, must be necessary to good interpretation; and that even then a competent knowledge of the physical phenomena of optical gratings is necessary, as well as a careful collation and comparison of the appearances with those presented under similar treatment by coarser objects, of which true dioptric images can be obtained. But even then it will be only a matter of interpretation more or less correct. All we know of *A. Pellucida* is, that there are striæ, or ridges, or something, occurring at intervals of so many to the inch. It is obvious they cannot be mere lines, as they appear to us; but as any "form" must involve another set of lines of at least double the minuteness, and probably far more, what is there can never be known, except from analogy and comparison with larger diatoms. As a rule we must get lines only in minute structures, and, as a rule, that appearance is certainly false. Nevertheless, the variations in distance between the spectra under gradually increased obliquity, and their consequent image-results, appears the most likely general method of ascertaining the true *proportions* of distances between striæ not all equi-distant, while the successive stopping out of the inmost and brightest spectra appears the most promising general method of revealing those fainter spectra which may lie hidden behind, and which reveal some periodic variation in structure at the distances of the apparent lines.

I almost feel as if I ought to apologise for this, since it will be read by those who know fully as much of optics, and infinitely more of microscopy than myself. The only microscope I possess is of the simplest, and I have only been able to repeat the simplest of Messrs. Abbé, Stephenson, and Crisp's beautiful experiments, not having either appliances or time for the more delicate ones. Hence, it may seem presumption to remark at all upon matters which may be presumed to belong solely to skilled manipulators. I can only say that the matter appears to me also to belong to the physical theory of light, from which side alone I have approached it; and that a clear understanding of the theory would appear to me to give valuable guidance towards manipulation. Whether or not any may gather hints from the above considerations, however—and even if I am proved to be wrong in any point—discussion of such points can hardly fail to become practical and interesting.

I had meant to add a little upon aperture, not feeling at all sure that the last word has been said about that yet, and believing that though much misused and misunderstood by some past opponents of the new theory, there yet remains something in the 180° idea. But even if time permit, I had better see the reception of these remarks before venturing upon any more.

Jan. 26. **Lewis Wright.**

COLONEL ROSS'S CONDENSING SMOKE-FILTER PIPE.



[22293.]—As there seems to be some misconception about the trouble in using the tobacco-pipe invented by me, which came out after I left Lonm, I would ask you kindly to publish the followg directions and sketch, by which your readers ll readily perceive that there is no more trouble in smoking it than there is with the ordinary pipe, whilst, on the other hand, two enormous advantages are gained. (*a*) The smoke is entirely divested of the offensive volatile oil containing the nicotine, being thereby rendered wholesome instead of injurious to the smoker, and quite inoffensive as regards the smell communicated to the furniture of a room, or, indeed, in a great measure to the pipe-case itself. (*b*) The pipe, if these directions as to manufacture and management are attended to, scarcely ever requires cleaning—say once a month—and then only about an inch and a half of the stem next the bowl, which can be done in ten seconds with an old hair-pin twisted. The sketch is taken from the pattern briar made for me to try, by Messrs. Frankau and Co., lying opened on the table before me. F. and Co. write to me that it will shortly be sold (to the trade, I suppose, as they are only wholesale makers), at 24s. per dozen, which will make it about 3s. per pipe to the smoker.*

The principal parts of the pipe are: *a*, the ivory non-conductor, screwing into the briar (*d*) towards the bowl, and into the vulcanite (*b*) towards the mouthpiece; *b*, the filter-chamber containing the sponge, divided by a screw about its middle; and *c*, the mouthpiece. If the pipe is managed as follows, the only part requiring cleaning once a month is the tube or bore of the briar part, from *d* to *a*. B is a sketch of my pipe-sponge, natural size. After a smoke, unscrew the chamber *b*, and press the small end of the now saturated sponge, *e*, *kept in its chamber*, against a wall, or anything where the smell does not matter; this will squeeze that part of the sponge nearly dry. Now blow strongly through *c*, and the pressure of the blast will force a great part of the volatile oil, &c., contained in the part of the sponge *b* into *e*, which is to be squeezed against the wall as before. A few repetitions of this simple process (which does not occupy half a minute, and, of course, leaves the fingers perfectly clean) will suffice to *completely* empty the whole sponge of its volatile oil, leaving a brown pasty substance behind, which can be completely dissolved out of the sponge (after two or three months' smoking, but even then it is not *necessary*) by putting it in a few drops of alcohol—or, better, ether—for a minute or so. If a sponge requires squeezing whilst the smoker is out walking, the most effective and rapid method is to drop it on a stone pavement or path, and squeeze it thoroughly with the foot by standing upon it. The "juice" is so volatile that the sponge, after one or two such squeezes, is dry enough to take up in the fingers and reinsert in its chamber without soiling them in the least degree. If the pipe is unscrewed, and the outer half of the sponge exposed to the air at night, it will be found perfectly dry in the morning and ready for work.

The makers have a bad habit of *cementing* the two screws at *a*, which is a *great* mistake, as the smoker then cannot get properly at the only part of his pipe which can become foul—viz., from *d* to *a*. These screws should be left to unscrew quite easily, so that the smoker can, if he requires, blow strongly from *a* to *d*, and clear away any obstruction.

The sponge should be cut with a pair of scissors (I fear mine was done very roughly) so as to fit with a thin part into the screw *e b*, the larger part of course being contained in *b*. It need *never be moved* from its chamber *e b*, except, as above mentioned, to be cleaned once in three months with ether. Surely there is no "bother" in this! Yet, people have written to me that "they prefer using cotton wool or charcoal" or Heaven knows what, "to do away with the bother of cleaning the sponge." **W. A. Ross.**

Hotel Beau Site, Monaco, Jan. 18.

KNEE BREECHES v. TROUSERS.

[22294.]—YOUR quotation from the *Lancet* of the 19th inst. misses, as a correspondent of that paper points out in the following number, one reason, and he thinks the chief reason, for the preference, and certainly the one that leads the labourer to transform his trousers into rude knickerbockers by pulling up the legs two or three inches, and then confining them tightly with straps just under the knee. Trousers interfere greatly with knee action at all times, particularly in walking, and most especially in the case of the agricultural labourer, who, being burdened with thick, hard boots, which allow scarcely any play at the ankle or instep, and being obliged to step high to get over the clods, has to flex the knee more sharply than other walkers. Trousers hanging free from the hip, there is always in the garment the exact length of the limb between hip and knee, and this entails a tiresome and embarrassing pull at the knee when these joints are constantly brought into action together. Breeches, on the contrary, being confined at the knee, a sufficient length can always be obtained above to allow of perfect freedom of action. I always wear breeches for a long walk, and so I think would many others if the comfort of doing so were better known. Let anyone imitate the labourer by pulling up his trousers two or three inches, and then fasten them firmly with tape just below the knee, and he will get a moderate appreciation of the comfort of breeches for walking and sitting.

Another advantage I may mention, as it is somewhat of the nature of a wrinkle for walkers. Everyone will have found how wet one gets about the knees in walking in rain, and the reason will be evident to everyone. At any time breeches may be dried without changing if you first place some folded paper (a newspaper) inside the garment between it and the limbs.

Lechlade, Jan. 21st., 1884. **W.H. Bo.**

CALICO PRINTING—REAGENTS FOR ALKALIMETRY — FATTY ACIDS — ALUMINIUM — EXTRACTING ANILINE COLOURS—THOUGHT READING BY MACHINERY — PERMANGANATE STAIN IN CARPET.

[22295.]—IN a query headed "Calico Printing" (No. 52858, page 460) information is requested as to the mode of making a certain liquor largely used in calico printing, of which one of the constituents is castor oil. I presume the querist refers to what is known as "Turkey-red oil," though his description is not very explicit. Several distinct preparations are used, and the one to which "R.W." refers is probably that made by mixing castor oil with sulphuric acid previously diluted with about one-third of its bulk of water, and leaving the mixture over-night. The acid is then washed away by a solution of common salt, and the fatty acids treated with ammonia, or a mixture of ammonia with soda or potash. The resultant Turkey-red oil consists chiefly of ammonium sulpho-ricinoleate.

A "Reagent" for use in alkalimetry (query 52831, page 459) which is suitable for all conditions has yet to be found. The relative delicacy of methyl orange, phenolphthalein, litmus, &c., depends much on the presence or absence of extraneous salts. A most valuable series of experiments on the subject of indicators has been contributed to the *Chemical News* (Vol. XLVII., pages 123, 135, and 184; and Vol. XLIX., pages 35 and 38) by Mr. R. T. Thomson. He shows that in solutions free from salts litmus and methyl orange are about equally delicate, but are far outstripped by phenolphthalein and phenacetalin. Phenolphthalein is wholly useless in presence of ammonium compounds. The behaviour of the indicators with various salts of neutral and acid constitution is exceedingly interesting. Thus sodium thiosulphate ("hyposulphite") is neutral to all four indicators. Na_2So_3 is alkaline to methyl orange, but neutral to rosalic acid and phenolphthalein. NaHSO$_3$ is neutral to methyl orange, but acid to the two latter indicators. Litmus and phenacetolin are useless for the titration of sulphites. As a rule, it will be found that methyl orange is indifferent to weak acids, and hence it may be used for titrating the alkali in sulphides, carbonates, silicates, borates, &c.; while phenolphthalein is affected by the weakest acids, and is valuable for titrating fatty and resin acids. If "Brine" is interested in indicators, he cannot do better than study Mr. Thomson's papers.

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* The pipes are now on sale at the Army and Navy, and Civil Service Stores, and, we believe, at the leading tobacconists. We have tried one, and think it does all Colonel Ross claims for it, and that henceforth our contributor's reputation as an authority on the *blow pipe* will rest on a double foundation. Careful adherence, however, to the instructions Col. Ross here gives is necessary, or purchasers may be disappointed, as no such information is given to buyers, and it is quite impossible to cleanse the pieces of sponge sold with the pipes in the manner Col. Ross directs. The end arrived at has long been a desideratum with smokers, and the means employed are used in the right place, and with the scientific knowledge one would expect in a chemist like Col. Ross. Instead of fixing a useless receptacle at the bottom of the bowl where the nicotine does not accumulate, Col. Ross intercepts its progress by what is really a process of cold distillation. The hot smoke, as soon as it passes through the non-conducting ivory ring, cools suddenly, and the nicotine is deposited on the sponge filter.—ED. E.M.

"Fatty Acids" (query 52450, p. 380) can be readily estimated by treating the fat with strong alcohol (neutral in reaction), adding a drop of phenolphthalein solution, and then adding decinormal caustic soda until a pink colour appears, which is not destroyed by shaking. 1cc. of decinormal soda represents 28·2 milligrammes of free oleic acid, 28·4 of stearic acid, 25·6 of palmitic acid, or 32·4 milligrammes of resin acids. If the sample of oil consists merely of free fatty acid and neutral fat, the quantity of the latter may be found by deducting the weight of fatty acid, ascertained by titration as above, from the total weight of the sample operated. If the mixture contain also some unsaponifiable matter, as hydrocarbon oil, it should be saponified by boiling with alcoholic potash; the alcohol boiled off, the soap dissolved in water, and the liquid repeatedly shaken with ether. The ethereal solution is separated, evaporated, and the residual hydrocarbon oil weighed. The weight, added to that of the fatty acids and deducted from the total, gives the neutral fatty oil in the sample; the process is of very general application, and capable of yielding accurate results. It is described in Vol. II. of my "Commercial Organic Analysis," which I believe the querist will find gives the fullest information on the commercial testing of fats; but, as it is quite out of print, he must obtain it from some public library or borrow it from a friend.

"Aluminium" (query 52529) is said by "Zelia Nalec" to have been deposited by him on gold and iron by an inexpensive process, and he wants to know if the discovery has any mercantile value. If the process is really simple and inexpensive, and he can get the deposit of any thickness, he has a fortune at his feet. But it is not the first time by many that the same claim has been made, and nothing has yet come of it. Similarly, I see that Mr. Grey's quotation of Mr. Weldon's demonstration of the impossibility of reducing aluminium by carbon has met with a rebuff from "A. E. S." (page 451). Nevertheless, until "A. E. S.", or some one else, comes forward in his real name, and produces aluminium in the way stated to be possible, I shall believe with Mr. Grey. There is more nonsense talked about the production of aluminium than any other scientific subject, now that perpetual motion and circle-squaring have been pretty definitely abandoned. What the *soi-disant* "practical" men cannot get into their heads is the fact that aluminium unites with oxygen with production of more heat than is evolved by the combination of carbon with the same weight of oxygen. If this is a fact, the reduction of aluminium by carbon must be hopeless. If it is not a fact, why do not "A. E. S." and other alchemists who believe as he does produce the metal they talk about? Carbon is cheap, sugar is cheap, and alumina is cheap, but where is their cheap aluminium?

I see on page 373 the question is raised whether "aluminium in a thin state" will oxidise? I had some leaf aluminium as thin as silver leaf for many years and it remained perfectly bright.

"Aluminium Sulphide" (query 52531, p. 352) cannot be produced in the wet way. It is formed by the action of sulphur on metallic aluminium at a red heat. It is decomposed by water into sulphuretted hydrogen and hydrated alumina. I do not think it could be prepared by heating aluminium sulphate with charcoal.

For "Extracting Aniline Colours" from paper (query 52559, p. 374) boiling alcohol will suffice. The aniline-red is readily removed in this way from the *Globe*, and no doubt the "Pink-un" and other coloured papers are tinted by the same means.

The "Thought Reading by Machinery" (query 52628, p. 396), I believe, on very good authority, to be effected by signs made by Mr. Maskelyne which, being seen by a confederate, are readily interpreted and made into automatic writing. The signs are of position merely, and not movements.

A "Permanganate Stain in Carpet" (query 52752, p. 437) can readily be removed by sponging with a solution of oxalic or sulphurous acid; or a mixture of acetic acied and hyposulphite would do. Better try on a small portion first, lest the colour of the carpet itself should be affected.

Sheffield, Jan. 26. **Alfred H. Allen.**

LATHE MATTERS.

[22296.]—In reply to "West Bromwich" *(22274, p. 4[illegible]), let me say that I shall feel pleasure in complying with his request if the Editor will grant space, and that my apology for not having* already done so is that so little can really be said about common lathe tools.

Fred. Carre (22275, p. 450) asks my opinion about the bed for a front slide-rest. He thinks that such a bed cannot be made with a gap. I confess I cannot see why not. Given the usual breadth of slide, it will be as capable of stretching two or three inches over the gap towards the face-plate, as is the usual form. I may, however, possibly misunderstand our correspondent, since he may be alluding only to the making of the pattern. If such is the case, let me assure him that, gap or no gap, such a bed is a very easy job: and if "F. C." and "O. V." are agreed that such a form would be desirable, I shall be pleased among "Letters to the Editor" to inclose a description, with sketches of the best way to make it. **J. H.**

[Our readers may be glad to know that in a private letter accompanying this "J. H." proposes future contributions, which have our hearty approval, and which will gladden the hearts of "West Bromwich," "O. V.," and a good many thousand more readers.—Ed.]

LATHES WITH FRONT SLIDE.

[22297.]—In reference to the lathe suggested by your correspondents, I can speak from experience as to the durability, as we worked a double lathe on that principle for many years by steam power, and it shows no trace of serious wear. It was used constantly for sliding short shafts, and was fitted with an automatic arrangement to stop at any required length.

The centres of this lathe are set over a little towards the front. The V is 1¼in. For amateur wear this would last 100 years without being resurfaced.

The long half-nut to move the saddle is not so good as the clutch-nut for several reasons. One great objection to this style of lathe is that the V-slot receives a great many chips, &c., and another is the general appearance is unsightly.

A far better plan suggests itself for amateurs who want to do other work besides screw-cutting, &c., and to whom the saddle-rest is a great nuisance. A back-geared lathe with the mandrel extended so as to receive nuts of various threads would cut screws to any required pitch with accuracy, and as quickly as a screw-cutting lathe, in a manner similar to that suggested by your correspondent, "J. L." some time ago.

The screw-cutting rest is carried on a strong round bar at the back of the lathe, and is instantly and easily lifted over when required. The appliance (called the former) is brought into connection with the hub by the same motion that brings over the rest into its place. Less than half a minute will convert the ordinary ornamental or wood-turning lathe into an effective screw-cutter.

When not required, the screw-cutting rest hangs down at the back of the lathe quite clear of the bed. Any ordinary back-geared lathe can be converted into a screw-cutting lathe which will give satisfaction.

Ordinary single-speed lathes would require to have a back-geared head to replace the ordinary head of their lathe. **Thos. M. Bear.**

Britannia Works, Colchester.

BEE-KEEPING.

[22298.]—Candy requires some care in using, as well as making. My experience is that it is best to run it, while hot, into an empty frame (holding 4lb. or 5lb.), and put that inside the hive. Last spring I placed it in cakes under the quilt, with unfavourable results; it dried too quickly, and also allowed an escape of heat. I should advise that candy be given early enough in the autumn for the bees to convert into syrup, and store away in the natural way (they always have to carry water to do this).

But why, it may be asked, not feed with syrup instead? Well, I treat the two plans side by side, putting a frame of candy in one hive, and feeding another with thick syrup through a bottle-feeder at the top. In 10 days the bees had converted and stored away all the candy; it was mostly sealed over, and the combs had nice patches of brood. In the other hive, the syrup hung out to dry as it were all over the hive, none sealed, and no brood: the candy is most trouble to make: but when once put in the hive, the work is done.

I cannot too forcibly state that no bee-keeper should require to feed in the winter; it should all be done in the autumn, when bees are active and able to store it away. Neither do I believe in the plan of giving them, late in the year, solid candy to cluster on; if given early, they can convert it all, and store it in the natural way.

Making the candy: The receipt given on p. 413 is right. I use a spoonful of cream of tartar to "break the grain." I place a sheet of newspaper on the table, and on this an empty bar frame: the frame is weighted down at the edges, and when the candy begins to stiffen pour in the frame.

In my district I find it a mistake to put flour of any sort in the candy. Bees should not be stimulated to breed in the winter, and with they get plenty of pollen from willow and l quite early in the spring.

I agree with "J. I. S." that Mr. Wils incorrect in stating that bees are partial to ce flavours in sugar. No doubt they will cons flavoured candy, and he may have sold it to keepers; but that does not prove they like it b

A. Watki

[22299.]—In answer to "Orderic Vital" (l 22249), candy making is frequently a ticklish I think it is on account of the difference in su and also the neglect of the details in mak With very few exceptions, I have succeeded with both candy and flour cake. The vinegar sh not be used for candy, as it causes the air to ac it and softens, and gets into a sticky mess, and down among the bees, sticking them together, doing more harm than good. Nothing shoul added; but the sugar, when boiled sufficien should be taken off the fire and stirred briskly u it appears to be setting. This prevents recryst ising. When bees are being fed with candy, th require water, and will come out for it if not su plied inside. Some beemasters do this by fountai metal plates, &c., for condensation. I have tried these, so cannot give any opinion.

Chilling brood is subjecting brood to a degree cold that causes them to die, either by allowing much ventilation or by exposing them too l when opening hive, &c. I do not know w temperature is fatal, and I never expose any m than a few minutes *in warm* weather; but I h not seen much of chilled brood in my own stoc Their hatching out when sealed depends on length of the exposure, and the state of the atm sphere. I do not call myself a bee-master, but I a bee-keeper, and very much interested in the pu suit; and I also should like bee matters ventila in "E. M.," but do not feel competent to undert it.

J. I. S

TRICYCLES.

[22300.]—In reply to "Rug" (letter 2225 think, with a little practice, he will be able mount any ordinary hill, if he has a well-m tricycle, in which the position of the rider is o his treadles, as he can then exert a considera backward pressure on the treadle at the end of stroke, which will carry the upper treadle i position for work. "Rug" suggests the tread being placed at right angles, but I think on c sideration that this arrangement would be fou to increase rather than diminish the difficul "Patent 5756," Sept. 1879, describes a tricy driven by opposite treadles and right-angled cra connected by rods, similar to a locomotive, whi renders the machine a good hill-climber.

Old Rug.

COMPOUND ENGINES.

[22301.]—I am obliged to say that I am too b with removing for me to answer "Young En neer" (let. 22278) fully. But as I have already st that with a receiver of 9 or 10 times the size of high-pressure cylinder, the variation in pressu about 1½lb. per sq. in. So that, taking this i consideration, you may calculate the power at y own leisure. Should you adopt a receiver of size to suit yourself, its volume, compared to of the high-pressure cylinder must be found, as by Marriotte's law, the volume and pres are in the inverse ratio, you can readily find pressure at any point, after which the theoret power is a matter of easy calculation.

Dewsbury. **Enginee**

OIL-GAS WORKS.

[22302.]—In letter 22282, p. 451, your co spondent "Os" asks two or three question beg to reply. Oil-gas, made by my retort is l preserved, and used by an ordinary gashold ordinary pressure similarly to coal-gas. A g of oil, petroleum, rosin oil, or other ordinary o melted fat, will yield about 100 cubic feet *good* and some useful brownish tar. Oil-gas ordinarily keep good, and I have, 25 years ag light the Royal Navy, had some compressed atmospheres. Even at two atmospheres press have kept it quite good for four years. No da of back pressure in the vertical pipe of feed-fu if the pipes and ways be clear.

James Copcut

Aylesbury, January 26.

PUMPING BY SUCTION.

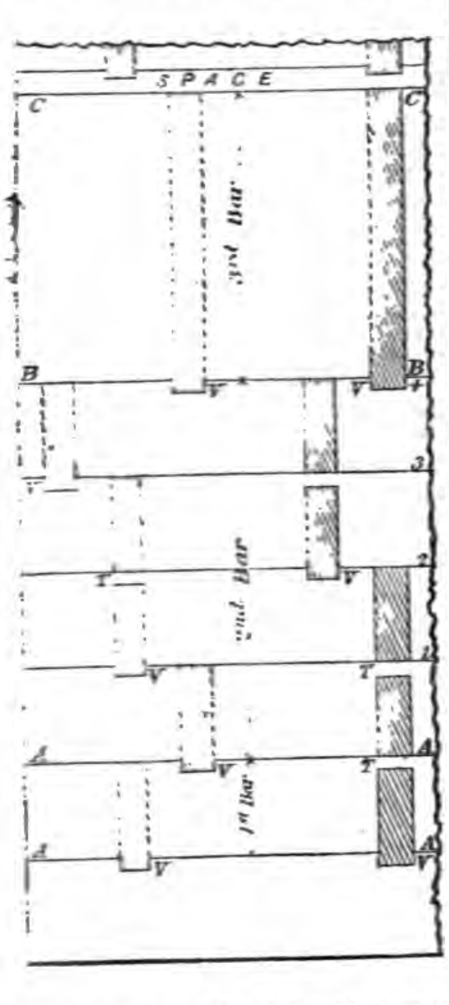
[22303.]—In last week's issue you gave an ex from another paper on p. 453, pretending to s how water can be raised 37ft. by "suction." I deny. I fail to see how a piece of wood with and leather fittings, in whatever form put toge possesses the slightest power to "suck" anyth It seems to me extraordinary that in the 84th of the 19th century there are so few people instrument, containing a set of perforations to test the reeds, and see that they all sound properly.

The next thing is to decide on the length to be taken to represent a minim, which we will assume to be half an inch. Having taken the strip of paper (I use stout smooth drawing or cartridge paper) of sufficient length for the intended tune and about an inch wider than the opening into which it is to be passed, we draw, near one edge, a perfectly true straight line as the basis of operations. Along this line, by means of the scale, are to be marked off the lengths of the bars in the tune, remembering that though no space need be allowed for *ordinary* bars, yet a final bar at the end of a phrase requires a small space to be left, say ⅛in.

Each bar is then to be subdivided into minim, semibreve, or crotchet lengths as required: a semibreve will be 1in., a minim will be ½in., a crotchet ¼in., a dotted minim ¾in., and so on. It is advisable to check this over two or three times, as mistakes will be very apt to occur at this stage. A wrongly cut hole can be stopped up or an omitted hole put in, but a mistake in the position of a bar will spoil the whole tune.

Having thus secured the two divisions, lines should be drawn at each mark right across the whole width of the strip, for which purpose we use the "set square" and "straightedge" to insure the lines being all parallel and all at right angles to the longitudinal line first drawn.

For a beginner the next step had better be to carefully mark off at each end of the paper, by means of the cardboard strip before mentioned, the positions of the lines of holes, marking both sides, and merely the centre of the holes. Then with the "straightedge" the longitudinal lines are drawn in, extending the whole length of the strip. We thus get the strip marked out into oblong spaces all of the same width (that of the holes), but varying in length according to the positions of the cross lines which mark off the bars and the notes.



It is then easy to mark which of these oblong spaces are to be cut out to form the tune. We then go over it again and put in the "bridges" of the repeated notes by shortening the first hole say ⅛in. in each instance; we also add the *extra* length of hole for the reason explained, and for which 1/16in. will suffice. These shortenings and lengthenings of the holes should be boldly marked, to catch the eye in cutting them out, and save carrying the cut too far. After a little practice it will be found unnecessary to draw the whole series of longitudinal lines, and the holes can be marked off at once by the aid of the divided strip of cardboard, and drawn in individually or even cut out at once.

I find a currier's knife with a sharp point is the best to work with, and the wooden block to cut on should be as free from grain as possible, or the knife is apt to follow that instead of the pencil marks. Annexed are a few bars of a hymn tune; but in order to bring it within the width of a column only a part of the width is included in the illustration. In this are shown the divisions into bars, as A, B, C; the subdivision into minims, as 1, 2, 3, 4; and a dotted semibreve occupying the whole of the third bar, with the succeeding narrow space to suit the end of the phrase and produce a pause. The "bridges" marked T, T, T, separate the successive repetitions of the notes, while the *extra* lengths of the perforations extending beyond the lines are seen at V, V, V, &c. For an orguinette, aurephone, &c, the holes would be altogether longer.

I may, perhaps, refer here to my reply to query 52577 on page 453, in order to remark that, speaking generally, and without reference to the question of key characteristics, it is easy to transpose any tune (within the compass of the instrument) so as to suit the scale employed. **A. S. L.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51843.]—**American Railways.**—The principal American railways with total mileage may be given, without any special order, as follows:—New York, Central, and Hudson River Railroad, 700 miles of track, capital stock £18,000,000; New York, Lake Erie, and Western, 1,500 miles, capital stock, £1,500,000; Grand Trunk of Canada, 2,332 miles; Pennsylvania Railroad, 2,047 miles; Baltimore and Ohio Railroad, 1,575 miles; Chicago, Milwaukee, and St. Paul Railroad, 4,465 miles, capital stock £10,000,000; Northern Pacific, 2,900 miles, capital stock £18,000,000; Union Pacific, 4,251 miles, capital stock £12,000,000; Central Pacific, 3,780 miles, capital stock £12,000,000; Chicago and North-Western, 3,552 miles, capital stock, £13,000,000; Chicago, Burlington, and Quincy, 1,960 miles, capital stock, £14,000,000; Wabash, St. Louis, and Pacific, 3,423 miles, capital stock £10,000,000. The querist asks why stocks fluctuate so much. Let me reply by referring to Northern Pacific stocks, which a few months ago were at 45, and have since gone to 22, while the preferred stock has declined from 85 to 50. Within the next six months they are as sure to get to the original figures, as the sun is to rise to-morrow. The explanation is about like this. Henry Villard, who, up to four days ago, was president of the road, was a dashing financier. He took hold of the road when it was incomplete and bankrupt. He borrowed money by millions, and last September the road from St. Paul to the Pacific coast was completed. When his work was done, a syndicate of bankers who had loaned the road a great deal of money instituted a "bear" movement in Wall-street—the money market of New York—and prices began to fall. Once having started on the downward rush, they kept on. People got scared, and they sold out of their stock. Like sheep falling down a precipice they went. The "bear" movement came at an unfortunate time, just when capitalists who might have picked up the falling stock had all they could do to take care of their own belongings. The Northern Pacific railroad runs through one of the finest and most fertile countries on the earth. There is no finer railroad property in the United States. Let me give another illustration as to how railroad property may fluctuate. Jay Gould, one of our great and unscrupulous railroad kings, acts the part of an Ahab to a Naboth. He sees a small railroad that he desires to secure for himself. He can get it without paying its actual value—in this way. We will say that the railroad is called the A. and B. C. railroad. Its stock is selling at 50. He tells a newspaper man that he proposes to run a branch of the D. and E. F. railroad parallel with the A. and B. C. This bit of intelligence makes men thirsty for more, for they know he can do it if he likes. In the meantime the A. and B. C. stock declines to 48. Many stockholders desire to sell if a parallel road is to be started. The newspapers get more "news"; presently it is the talk of the "street." The name of the firm from whom the steel rails have been purchased is given: elaborate articles are written, setting forth what a splendid thing the new line will be to the D. E. and F. road, as a feeder, while the A. and B. C. company will soon become bankrupt. The A. and B. C. stock goes down, in all probability, to 20, and Gould, who never had any intention of building a parallel line, buys all the stock he can. Then the newspapers learn that he has altered his mind, and is not going to build a parallel line, and up goes A. and B. C. stock again to 50. If Gould chooses to hold on to his stock he can; if he sells, he makes a tremendous profit. If my English friends ask whether or not it is wise for them to invest their money in American railways, I answer unhesitatingly in the negative, unless the investor has some special information from a friend who knows. American railways are a lottery to the uninitiated. There are fifty ways of investing money in this country in which large rates of interest are obtainable; but the small holders of railway stocks are in great danger of being badly squeezed by the big men. There is no point where money can be invested to better advantage than right here in Dakota; but a man should come and see what he is doing with his money, unless he has a friend on whom he can rely.—R. M. Tuttle, Mandan, Dakota, U.S.A.

[52256.]—**Brush Dynamo.**—To "W. H. E. Coventry."—I cannot see how my machine can short-circuit itself. I may say, since your reply appeared, I have altered my commutators as you suggested, by replacing my former ones with a proper "Brush"; but the results are not so good. How do you account for this? Formerly I could red-hot my candles, but now not even this will occur, and I must think winding my A. with smaller wire will give better results—say four gauges finer. At present the slightest separation of the candles will break the circuit. Is there any particular mode of placing the commutator plates with respect to the coils? Mine are soldered centrally opposite their own coils on end of wire, and the brushes laid on just as the coils come out of F.M.'s—Williams.

[52302.]—**The Cheapest Food.**—From personal experience in a long course of years as a plate-mill furnaceman, there is nothing to equal dandelion beer with bitters to taste, such as wormwood, gentian, or buckbean, with a little ginger and sugar. Fermented and bottled it is a good, healthy stimulant. The dandelion acts on the liver, and the bitters keep the stomach in good order. 2nd. There is nothing better for free and largely drinking than oatmeal and water. I have seen vast quantities of it used in summer time in the ironworks by men and boys when in the most profuse perspirations, and never saw any ill effects, however large the quantity one drank. It is very refreshing and wholesome, and surely that is all any workman really requires. I am not now connected with the ironworks. As a matter of choice, I invariably have simple water to my midday meal.—T. Taylor.

[52408.]—**Ringworm.**—A very simple remedy for ringworm, and I can vouch for its efficacy, is the application of oil of tar. The way I have applied it is to turn up the bottle containing it, then take out the cork, and gently touch the place affected: two or three applications is usually sufficient, and often one will do. If the patient is a child, its hands should be held for a few minutes while the smarting ceases, and to prevent its rubbing the oil or getting it into the eyes, where it would be painful.—J. Thorp.

[52414.]—**G. W. R. Engines.**—The following are the dimensions of the 4-coupled (trailers) single framed side tanks built at Swindon. Cylinders 16 by 24; boiler, length 10ft. 6in., diameter 4ft; outside firebox, length 5ft. 1in., breadth 4ft. 1⅛in.; inside firebox, length 4ft. 6in., breadth 3ft. 6in.; height 5ft. 6in.; area of firegrate 15·75; 161 tubes 2in. diameter, 14 tubes 1⅝in. diameter (175 tubes total). Heating surface: Firebox, 87 sq. ft.; tubes, 999 sq. ft.; total, 1,086 sq. ft. Diameter of leading wheels, 3ft. 6in.; diameter of coupled wheels, 5ft.; centre of leading to centre of driving wheel, 7ft. 6in.; centre of driving to centre of trailing wheel, 5ft.; extreme length of frame, 25ft. 2in. Tanks hold 790 gallons. Weight of engine in working order. Leading wheels, 9tons; driving wheels, 12tons 2cwt.; trailing wheels, 12tons 2cwt.; total, 33tons 4cwt. These dimensions apply to engines 3-6 (1867), 455-470 (1869), 613-632 (1871), 967-986 (1874), 1401-1420 (1878). All these have domes. Nos. 1445-1452 are slightly larger and have no domes. The cylinders of these are 17 by 24. The side tanks built at Wolverhampton have leading and driving wheels coupled, 5ft. diameter, and cylinders 15 by 24. Some have had cylinders enlarged to 16 by 24. I have no further dimensions of these. The broad gauge goods have 5ft. wheels, and 16 by 24 cylinders. I refer to those built at Swindon about 18—.—Meteor.

[52465.]—**Belt Working off Pulley.**—It appears by "Engineer's, Dewsbury," answer to the above query, that he would have us to believe that his answer is to be final. I think it is hardly fair, "Engineer," until you have tried the case (under consideration) on two perfectly horizontal shafts by bringing the shafts nearer together or further apart, as the case needs. The illustration that you give is a very poor example of belt working off pulley when the shafts are furthest apart. If correspondents would give their advice a little more from practice, it would save a lot of unnecessary space and twaddle. Let me say that I have had two cases of belt working off pulley at the side were nearest together (only this last week)—one

casing raised above barrel outside 2ft. 6in. above centre of boiler. Inside firebox: Length, 7ft. 4in.; width, 3ft. 5in.; height, 5ft. 3½in. (front), 2ft. 3½in. (back). Heating surface: Tubes, 1,084 sq. ft.; firebox, 110 sq. ft.; total, 1,194 sq. ft. 192 tubes, [illegible] diameter, 10ft. 4½in. long. Weight in working order: Leading wheels, 12tons 18cwt.; driving wheels, 13tons 15cwt.; trailing wheels, 12tons; total, 38tons 14cwt. Can any reader say what these engines are numbered?—Meteor.

[52618.]—**Seismometer.**—J. Byatt's query is too general, since the kind of apparatus used will depend on the locality—i.e., on the kind of earthquake shock to be registered, and also on the particular elements of the shock it is desired to record. He should look up *Transactions* of the Seismological Society of Japan, in Vols. III. and IV. of which are described forms of pendulum seismographs. See also *Philosophical Magazine* for Sept. and Nov., 1881. In No. 154, *Quart. Jour. Geological Society* for May, 1883, p. 218, is a short description with diagrams of a seismographic apparatus as used by Messrs. Gray and Milne in Japan. This, which is the most recent form of the apparatus, "is designed to give a complete record of the form, magnitude, direction, frequency, time, and duration of the motions of a point of the earth's surface during an earthquake." The mechanical principles involved in its construction are very elaborate. To do useful work J. Byatt should become acquainted with other observers—see, e.g., "Report of Committee on Earthquake Phenomena." B.A. Report for 1882, p. 205.—F. G. S.

[52623.]—**Mural Decoration.**—My advice is: Get some experienced house painter to prepare the walls and to give them one, or, if necessary, two coats of what they (house painters) call flatting. On this, when dry, you should draw your decorations in white chalk, or, better still, tailor's pipeclay. If you use the former, let it be soft, or it will not mark on the paint. Next come the colours: If you want yours to look like your friend's, you must use colours mixed with turpentine instead of oil. If you use artist's colours, use turpentine only as a medium. I shall be pleased to give any further hints that may be required as your work proceeds, and if you care to advertise your address, I would do so by letter, which would not necessitate your waiting a week.—Edwd. Flowerday.

[52623.]—**Mural Decoration.**—As no person has yet suggested that the colour for the wall which was laid on by Italian workmen in her friend's house, might have been mixed in with the plaster on the wall, I may be pardoned for occupying space on the subject. A celebrated London artist was among the first to use plaster which was coloured before being applied to the wall. I think it was Sir Frederick Leighton. I saw it mentioned in a recent number of *Harper's Magazine*. I could not, however, see how this decorating could be done by an amateur, especially a lady one; as, beyond the physical power, a considerable experience would be required as to the permanency of the colour, and how far it would withstand the action of the lime.—A. Howland.

[52623.]—**Mural Decoration.**—I am much obliged to "Os" for his kind interest in my intended work, and for his mention of "flatting," which is, no doubt, the material I require. Since Mr. Lancaster's reply to my questions I have obtained an excellent little book, entitled "The Paperhanger's, Painter's, Grainer's, and Decorator's Assistant," containing much information, given in a practical style. I have, I think, decided to work in paint, not in distemper, on account of the greater durability of the former, although I have now learnt from a house painter the proper mixture for distemper to render it sufficiently firm, even when rubbed or cleaned. "T. B. C." will have discovered, from my hint to Mr. Lancaster that, as Dickens puts it, I am "deprived, by the wrongs of my sex," from the possession of that domestic treasure which the wise man tells us, "whoso findeth, findeth a good thing." I have, therefore, to be content with a husband, and, as we must not encroach upon the valuable space of the Mechanic's pages with discussions as to the sentiments of "our sisters, our cousins, and our aunts," I will only add that he, perhaps, from having known me undertake a few previous things rather beyond the pale of ordinary woman's work, and get through them, does not seem so hopeless as to the realisation of my project as "T. B. C." appears to be.—E. C. N.

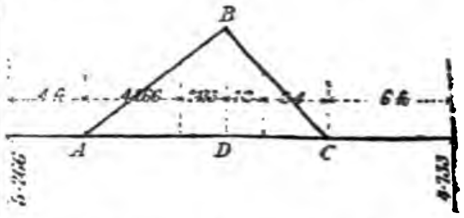
[52623.]—**Mural Decoration.**—Our fair correspondent wishes to know "if, after I have painted my wall over with a coat of distemper, I can paint the design over it without further preparation": I am not quite prepared to answer this question in the affirmative because of the supposition that "E. C. N." intends to paint in oils. Distemper grounds absorb the oils, and consequently the colours will not blend. The effect would be similar to writing in ink on a piece of fresh-planed wood. Therefore I should not like to advise in this point, which is almost certain to end in failure. If, however, instead of the painting in distemper is resorted to, the walls will only need a first preparation of being thoroughly cleaned, and then, secondly, washed over with a colour-wash of a delicate pink salmon tint. This will, perhaps, give more repose as a background than either a pale grey or drab, as some portion of the background must appear. The colour-wash being first properly prepared, size, well melted, must be added to it, in the proportion of, say, four pounds weight to each pailful of colour-wash. This, if properly done, ought to make a firm ground, which does not hereafter rub off. In painting in distemper the colours must be prepared to obtain the like result; that is, if it is necessary to add so much size to the colour-wash to prevent it coming off on the clothes (like chalk or whiting), the colours must be mixed with a like preparation; but, as in the operation of painting the size will dry, perhaps, too quickly, in that case the colours might with advantage be mixed with clean flour paste of a consistency which will enable them to work freely from the brush. But mural decoration of this kind is an art, and can only be acquired by practice to insure success. Under any circumstances, the undertaking in the hands of an amateur will, and must be, attended with many disadvantages. In the first place, granting that everything was truly and properly prepared as directed, the painting, when done, would last only so long as the animal or vegetable substances which bind it withstand the action of the atmosphere; consequently, in our moist climate (winter especially) it would get somewhat deteriorated in perhaps three or four years at most. Oil painting is different; but that, to be effective, cannot (as already observed) be executed on distemper ground without absorbing the oils, and thus preventing the proper blending of the tints. As "E. C. N." explains it, it is very clearly seen why her friend's drawing room "looks dull"; but I am not in the secret of the remaining process, unless the colours have been mixed with the white and yelk of eggs (the former for all light colours and the latter for the darks); this, when dry, would form with the lime a size that is insoluble. I see another contributor ("T. B. C.") has replied to this query. I fully endorse all he says; as to his "pale grey" ground, all that greatly depends upon the subject to be executed, and no definite rule can be laid down. As to colours, I know of no particular work which treats upon this subject fully (an art we should call it); however, in the choice of colours care must be taken to confine them to those that lime will not deteriorate, and which also will not be altered by the action of light. If "E. C. N." prepares her own colours, they can be obtained in the crude state at any oil-colour shops; but I am mistaken if they will not require much time in their manipulation. I append a list of colours likely to be useful. As an amateur, I would not advise "E. C. N." painting her walls in oils without first trying her skill elsewhere on a smaller scale. *Colours for Distemper Painting.*—For Whites: Chalk and lime to be used. The latter hardly advisable perhaps, on account of the preparation required to make it available as a vehicle. For Black: Soft black chalk, or charcoal black. Lamp black is most intense. For Yellows: Naples yellow, Indian yellow, gamboge. The different yellow lakes; but many of these are not so permanent if exposed to a strong light. The Reds: Carmine (not permanent), cinnabar (or vermilion), metallic; it might be acted upon by the lime. The Lakes: Indian lake, scarlet, and crimson do. Brown pink (one of the yellow lakes), a vegetable colour. Madder lake (red colour): This may be acted upon in two ways to form other colours. First—it may be changed into a dull orange by the action of alum. Secondly—to an orange yellow by the action of hydrochloric acid. The Earth Ochres: Yellow ochre, &c. The Umbers: Light and brown. The purples obtained of various tints by the admixture of reds and blues. The Blues: Prussian blue, ultramarine, smalt; but I know very little of this latter colour. The Greens: Most of these are metallic; but may be formed by the mixtures of the yellows with blue. The Browns: Bitumen, asphaltum. Prussian blue, if heated to an intensity towards redness, will produce two or three shades of colour (varying to the degree of heat obtained), from yellow ochre to dark ochre and black. A good brown can be obtained by burning whalebone to a fine powder, and then levigating it.—Geo. H. Lancaster.

[illegible]—**Varicose Veins.**—With all respect to "E. W. ...," I still recommend to "Poor Sufferer" the bandage described. The fact is, while "E. W. ..." has been reading his book, I have been wearing the bandage, and, since September, as neither gangrene has set in nor my leg has rotted off, but is in a more healthy state than before, the question solvitur ambulando. I have also worn Martin's bandage, but rejected it because the skin secretions did not escape, and my leg showed a tendency to break out in ulcers. Of the two, Martin's bandage is much the more powerful, and less easy to apply; its advantage is in its cleanliness. The bandage I described no doubt may be used as described by Dr. [illegible] or one of a different kind may be referred to; but the one I mean is nothing more than a long length of elastic brace material, and need not be applied to produce more than a gentle pressure; and practice and perseverance are not necessary to apply it. For comfort, I strongly recommend the one I have mentioned, and having used both, I can speak to facts within my own experience. Don't be frightened, "Poor Sufferer."—H. P.

[52653.]—**Electrical Currents.**—I think "Antares" will allow that his water analogy is correct when he considers what would be the relative effect if he were to place his hand in a large volume of water with 3ft. head, and then in the way of a small stream falling from 30ft. Cannot he see that the first case is the low potential current carrying a large amount of energy along in a mild way, and the second is the same amount of power used to propel a small quantity of energy at high speed? With respect to the destructive nature of high-tension currents, the force of the water falling on his hand from 30ft. above would soon convince him that the same power can be expended in different ways. By the way, in my note of last week read "presence" for "pressure" of magnitudes. The last extract from the Blue Book probably only refers to those cases where a constant E.M.F. is maintained. Registration of this would be effected separately. I fail to see what are the two applications of the word "volt"—it only represents the E.M.F. of the "body," or "quantity," or "current" of electricity which is passing in a conductor; or, in other words, the height from which it is falling.—Cosmos.

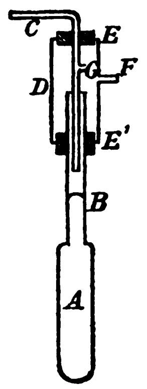
[52654.]—**Point of Greatest Transverse Strain on Girder.**—I am sorry you should have been put to the expense of engraving a block for the reply given by "Palmer, Accrington," as it is no solution at all of the problem. I have worked it out myself by calculating the strains in "foot-tons" at several points, plotting these as ordinates, and so obtaining a curve of strain with an approximate maximum; but the method is both troublesome and tedious, and I much wish to obtain something less complex, and if possible more exact. Where are our mathematical correspondents?—Querist.

[52654.]—**Point of Greatest Transverse Strain.**—The pressure on each bearing will be inversely as their distances from the centre of gravity of the load, 5·266 tons and 4·733 tons. The moment of the force tending to break the beam at A is 5·266 tons × 4ft. The moment of the force tending to break the beam at C is 4·733 tons × 6ft.; at D it is 5·266 tons × 10·4ft., less the weight of A D B = 6·4 tons × 2·133ft., the distance of its centre of gravity from line B D, or 4·733 tons × 9·6ft., less the weight of B D C = 3·6 tons × 1·2ft., the distance of its centre of gravity from line B D. At any point between A and D it is 5·266 tons × its distance from the point, less the weight of the load to the left of the point × the distance of its centre of gravity from the vertical line through the point. And similarly for any point between C and D it is 4·733 tons × &c. But with right instead of left, then, if the results of these calculations at a sufficient number of points are set off to scale on vertical line drawn at the points, a curve drawn through the top ends of these lines will show the ratios of strains at any point, and where the curve is highest will be the point of greatest strain. From the top of the line at A to the left-hand bearing, and from the top of the line at C to the right-hand bearing, the line showing the ratios will be straight. What the actual strains are depends on the section of the beam, which is not given. "Querist" should attend classes or read on "mechanics" in order to do these questions for himself.—J. S. C.



[52664.]—**G.N. Engines.**—I do not think engine No. 70, having outside bearings, is a new one, as engines with outside bearings have not been built for the G.N. since 1866. I do not know No. [illegible]; but if it is a "mixed" engine it will be like 67 and 68. No. 67 has 6ft. coupled leading and driving wheels, and 17½in. by 24in. cylinders. Both 67 and 68 are rebuilt engines. The springs of these engines are underhung from the outside frame.—Meteor.

[illegible]—**Continuous Temperature.**—A small apparatus, known under the name of "thermostat," is capable of obtaining the desired effect. It can be made of glass by anyone a little experienced in the art of glassblowing, or it may be obtained at a trifling cost from Cetti's or any other glassblowers. Its construction may be easily understood by the accompanying diagram. A is a



good-sized bulb containing mercury; G represents the tube connected with gas supply. It enters the tube B, and may be inserted into the latter to variable depths by means of the connecting tube D, and the airtight corks E and E'. F is the tube which connects the thermostat with the heating burner. G is a pinhole, blown or bored into the tube G. The manner of using this instrument is as follows:—Connect G with gas supply, and F with the burner by long flexible indiarubber tubes. Plunge A into the liquid, which is to be kept at a constant temperature, and fix the instrument in an upright position. Heat the liquid by applying the burner; when the desired temperature is obtained, push G into B until it just reaches the surface of the mercury. By this means the gas is almost entirely shut off, G only remaining for its passage into the burner; the result will be a very small flame, insufficient to keep up the temperature of the liquid. When the latter cools down the mercury contracts in A, and the passage of the gas becomes enlarged; this goes on until an equilibrium is reached, which allows just enough gas to reach the burner to keep the temperature as required. By means of this apparatus I have kept constant temperatures, varying within 1° C. for days and weeks.—Organic Chemist.

[52691.]—**Assaying.**—It is usual to add 16 lead for 1 copper, and that will be sufficient. A cupel that weighs a little more than the lead to be cupelled will be large enough.—Augustus.

[52692.]—**Cleaning Sponge Cloths.**—In reply to "Engine Shed's" inquiry, there are several methods of effecting this. I do not knew the exact method adopted at Crewe; but the cheapest and simplest way is to make an alkaline solution of the usual washing kind—i.e., by boiling lime and the alkali of commerce (50 or 52 per cent.) together in a steam-jacketed or other vessel for 2 or 3 hours, stirring frequently till well dissolved; draw off the mother liquor to a settling tank or tanks, reserving the settlings of the boiling tank for use in the next boiling. The mother liquor ready for use is generally tested by the ordinary Twaddell hydrometer (which can be obtained at any scientific instrument shop). It is best to make a good strong mother liquor, not less than 20° Twaddell, so that the washing liquor can be regulated, more especially if the cloths are very dirty and mineral oils have come in contact with them. The cloths being transferred to the boilers (I prefer jacket boilers) are allowed to soak in tepid water a short while, and then the washing liquor is turned on in the proportion of two gallons of mother liquor to one gallon of water. These proportions of both water and liquor. however, can be regulated and made weaker or stronger, according to the condition of the cloths. They are then boiled an hour or more, and the cloths turned over occasionally to let the grease escape from the mass; the foreman can easily satisfy himself as to when the cloths have been boiled long enough, and the grease saponified, by taking a cloth out and washing by hand in a pail by means of hot and cold water. I do not advocate too many cloths being boiled at a time; if too many are thrown in they form a dead, solid, adhering mass, making it difficult for complete separation of the grease. A moderate quantity will be done in one-third the time, and most effectually turned over and cleansed. After transferring from the boilers to the ordinary washing and heating engine, where they must be well washed in a plentiful supply of water, the cloths are then "hose-piped," or, what is better, are thrown into a centrifugal drying fan (in use, I believe, at Crewe—the maker's name I have forgotten). During the rapid motion of the fan a jet of cold water is made play on the cloths, which is continued till nothing but clear water runs from the discharge pipe at the foot of the fan. It is best not to fill the revolving fan too full of cloths, as this process can be completed in a few minutes, and can be repeated often with plenty of water. The transfer of the cloths to the usual drying room completes the cleansing. The grease rising to the surface in the boiling pans is ladled into tanks, or is best run down into a tank below the level of the floor. In doing a quantity, it is important to see that the process is regular and rapid, and that they are turned well over in the boilers, so that the grease rises in a good scum. In the washing and heating engine give the cloths plenty of water.—Chemicus.

[52713.]—**M.R. Engines.**—To "Historian, M.I.M.E."—The Midland Railway Company have decided to adopt the red colour now to be seen upon some of their engines. The paint is not only cheaper, but is said to be more durable. A trial has been made, in which engines painted green and red about the same time were examined two years afterwards. The result was said to be much in favour of the red colour, which is therefore to be adopted.—Meteor.

[52716.]—**Lathe.**—With the assistance of these sketches I think you will find no difficulty in making the pattern you require. If you should meet with any hitch, call again. But it is not a case of "arms and other parts to casting of headstock," but of a headstock of a different type, and differently proportioned to that which I have described. Back-gearing and screwcutting additions mean a heavier casting, and properly, cone bearings; also they mean a wider space between the uprights to take the gear wheels, and then, in addition to these, the arms for the back spindle. Figs. 1, 2, and 3 give views of a headstock such as you require. The width between, 7¼in. or 7in. between facings, is made to take a three-speed belt pulley of 3in., 4½in., and 6in. diameters respectively, each of 1½in. thickness, and gear wheels 1in. thick. If you choose instead to have a gut or a rope pulley, you can narrow the width space a little. The gear wheels are of 18 and 54 teeth respectively, giving power of 9 to 1, and the centres of their bearings are 4⅜in. apart. In making the pattern you can set to work, and frame together just as described in the first article on "Cheap Lathe," p. 165, joint, dowell, &c., working, of course, to the new dimensions. Don't, however, cut the arms for the back gear out of a piece with the sides, else you get short grain. Put those arms on with a stump tenon in the manner shown on Fig. 4, glueing the hollow in afterwards (Fig. 5, *a*). The facings for the mandrel bearings being in the *joint* are fastened on, together with their prints (Fig. 6, *a*, *a*), that is, if you choose to cast the holes in, though leaving them to be drilled insures a sounder casting in a small lathe. But the bosses for the *back* spindle are wired on Fig. 6, *b*, *b*, where they are shown slid back a little on their wires. You must allow all these boss facings ¼in. thick in the pattern, so that you may have something to face off the casting. The arrangement for the back centre is as follows:—The mandrel passes through both

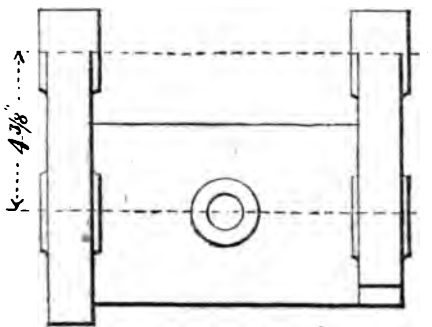


Fig. 1. Plan.

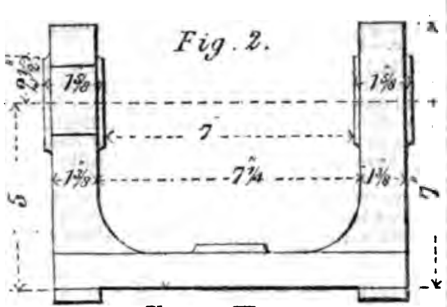


Fig. 2.

Front Elevation.

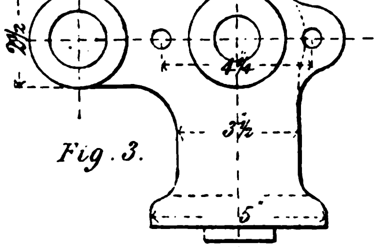


Fig. 3.

Back View.

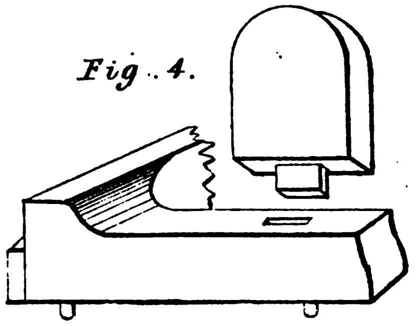


Fig. 4.

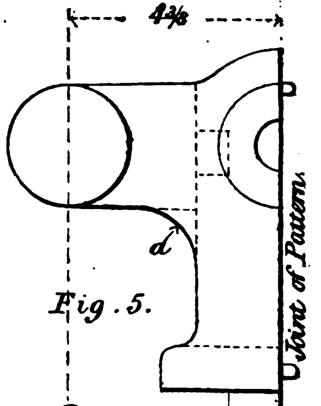


Fig. 5.

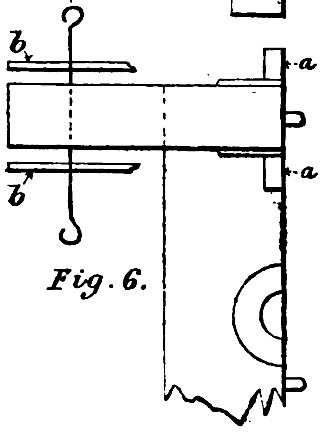


Fig. 6.

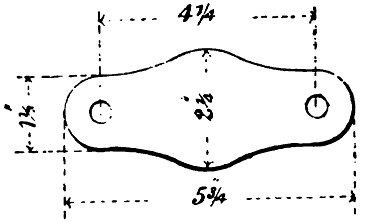


Fig. 7.

ends of the headstock, and is prolonged about 3in. beyond the tail end to carry the first cog-wheel of the screw-cutting train. A bridge, Fig. 7, is cast, and maintained, say, at a distance of 4in. from the back of the headstock casting by means of distance pieces, the centres of which are given at Figs. 3 and 7. Then the actual dead centre passes through the middle of this bridge, and is held, as before, with adjusting nuts. You must make the poppet pattern heavier also for a back-geared lathe than for one intended for hand-turning. The design may remain as it is at present; but I should make the mandrel 1¼in., instead of ⅝in., and add ¼in. to all thicknesses of metal. Driving-wheel, of course, is altered; crank should be double; heavy flywheel is necessary. A 5in. back-geared, screw-cutting lathe is a very different thing from a 5in. cheap wood or plain metal-turning lathe, and requires a high degree of manipulative skill and good appliances to construct successfully.—J. H.

[52718.]—**Dog Poisoning.**—"M. C. H." will find sulphuretted hydrogen in its concentrated form a very quick and powerful poison. Obtain about 1lb. of iron sulphide and put it into a large beaker, pour some hydrochloric acid, diluted with its own bulk of water, over it; cover with a glass plate and wait until the beaker is well-filled with the gas. Remove the glass plate and dip the nose of the animal into the gas. It will die instantaneously. It is hardly necessary to caution against inhaling any of the concentrated gas one's self. It is also absolutely necessary to perform the operations in the open air.—Organic Chemist.

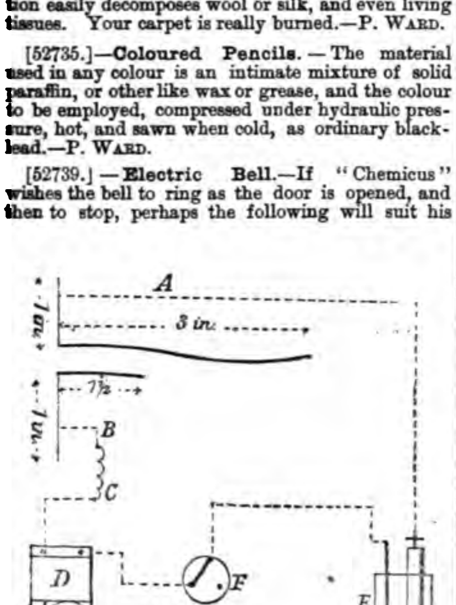
[52727.]—**Quantity of Water Used.**—I think Mr. Webber will find the following answer his purpose:—$2\frac{1}{2} \times D^2 \times \sqrt{P} \times 6\frac{1}{4} \times 60$. For 40lb. press. $= 2\frac{1}{2} \times \cdot375 \times \cdot375 \times 6\cdot32 = 2\cdot22185$ cub. ft. per min. Then $2\cdot22185 \times 6\cdot25 = 13\cdot8865$ galls. per min., and $13\cdot8865 \times 60 = 833$ gall, per hour. For 60lb. press. $= 2\frac{1}{2} \times \cdot375 \times \cdot375 \times 7\cdot74 = 2\cdot721$ cub. ft. per min.; then $2\cdot721 \times 6\cdot25 = 17\cdot00625$ galls. per min., and $17\cdot006 \times 60 = 1{,}020$ galls. per hour.—Wm. Routledge.

[52731.]—**Axle of Electrical Plate Machine.**—I have a machine with plate same size as "W. H. H.'s," only not quite such thick glass. My axle is made of oak, and the hole is ¾in. diam. I first cut circular pieces of chamois leather to fit caps, with the hole cut in the middle, and fixed them on to each with "Giant cement," and when perfectly dry fixed the cap on to the glass plate. I got the caps turned so as to fit tight on to the axle. The cement when set is a kind of thin layer of jelly, so that when the machine is put before the fire it allows the glass to expand, and does not crack, as one did which I made with glue. I have got from 1½in. to 2in. with my machine.—Plate Machine.

[52732.]—**Permanganate in Carpet.**—I am afraid you will never remove your stain so long as it is a carpet. The permanganate in a strong solution easily decomposes wool or silk, and even living tissues. Your carpet is really burned.—P. Ward.

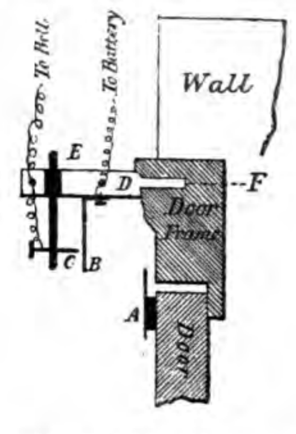
[52735.]—**Coloured Pencils.**—The material used in any colour is an intimate mixture of solid paraffin, or other like wax or grease, and the colour to be employed, compressed under hydraulic pressure, hot, and sawn when cold, as ordinary black-lead.—P. Ward.

[52739.]—**Electric Bell.**—If "Chemicus" wishes the bell to ring as the door is opened, and then to stop, perhaps the following will suit his purpose:—A is a spring of hard brass about 1-16in. thick and 1in. wide, fixed on to architrave moulding of door frame; B is a similar spring fixed on to door, the connections are shown in sketch; C being short helix where the door hinges, to prevent the wire breaking; D, the bell; E, battery; F, switch to cut off when not wanted.—Practice.



[52739.]—**Electric Bell.**—It would be of advantage if "Os" would only bear in mind the excellent advice given weekly "to write what he knows, and as much as he knows, but no more"?—*vide* his reply to "Chemicus," pp. 541. Could much greater nonsense be written, seeing that every bell-fitter knows the thing to be done is one of the simplest things in the trade, the "apparatus" costing about 2s., and being in common use on shop and area doors without number. He seems to have heard of the merits of Leclanché's battery, but the fact that in its best form (as in use for the last four or five years), it is made without a porous cell, is apparently unknown to him, and so he dogmatises and misleads.—One Jealous of the Credit of "Ours."

[52739.]—**Electric Bell.**—A is a piece of wood or metal screwed on to door. D is made of wooden bar let in to the door frame at top right-hand corner, supports (E) a wooden rod which carries the brass screw (C). B is a piece of watch or small clock spring bent, and then hardened at a right angle; a hole is drilled (or punched) while soft, and the spring, well brightened, is screwed on to the block as shown. When the door is opened, A presses the spring B against the screw C, and when returning to its place A presses B away from C. Thus the bell will only ring when door is being opened. The block may be 6in. long, and A may be made of steel spring, which gives longer contact. I should advise use of new Leclanché battery; but why not use porous cell?—Cosmos.



[52747.]—**Electric Microscope.**—This is evidently a contradistinction to the oxyhydrogen microscope, such as used to be shown at the Polytechnic.—P. Ward.

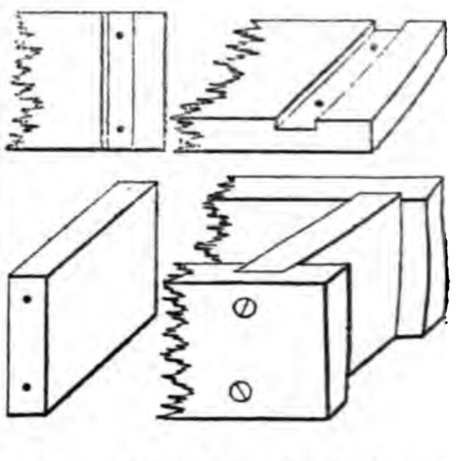
[52751.]—**Recovering Silver.**—Pour some concentrated nitric acid on the electroplated iron. It will dissolve the silver, leaving the iron intact. When the operation is finished, pour the liquid off, and dilute with water; add a solution of common salt. Silver chloride will settle as a bulky precipitate, which must be filtered and well washed. Remove the silver chloride from the filter, put it in a porcelain dish, and add a few cuttings of sheet zinc and a little water, and allow to stand for a week or two. The silver will then be reduced, forming a heavy grey powder. Remove what remains of the zinc, wash well, and melt in a crucible, adding some sodium carbonate as a flux.—Organic Chemist.

[52751.]—**Recovering Silver.**—Procure an earthenware pan (of course the size is determined by the quantity of stuff to be recovered), and into it empty the pieces of iron till about three-quarters full. Cover them with concentrated nitric acid, and gently warm. As soon as all effervescence is finished, the pieces may be fished out, and replaced by others. This goes on till the effervescence becomes slight; the pieces of iron being washed, and the washings added to the main quantity of acid. Muriatic acid is now added, until no further white precipitate is thrown down, at which point the whole is heated and allowed to stand for some time; the clear liquid is decanted off, and the precipitate thrown into a thick calico bag, and well washed with hot water and dried. Mix the dried mass with carbonate of soda and fuse in an earthen crucible, when the silver will be found at the bottom.—D. Williams.

[52753.]—**Copper Ores.**—Weigh out about 5grm. into a porcelain crucible, and heat for about 10 minutes, to oxidise sulphur. Transfer to a porcelain basin, add HNO_3 and H_2SO_4, heat till copper is dissolved, evaporate down to a small bulk, to get rid of HNO_3, add a small quantity of water, and filter into a platinum basin, or small beaker, washing the filter paper 2 or 3 times with water. A quart Daniell battery is about the best to use. It consists of a cylinder of copper, in a solution of sulphate of copper (concentrated), in the centre of which is placed a porous jar containing a rod of zinc, in dilute sulphuric acid. If the ore has been filtered into a platinum basin, connect the zinc pole of the battery so that it touches the outside of the basin, and the copper pole connect to a platinum wire, and allow it to just dip into the liquid. Put away for about 6 or 8 hours, when it will be found that the copper will be precipitated into the basin, and should show its characteristic red colour. The liquor, which should be perfectly free from copper, is emptied out, and the basin washed two or three times with distilled water, and finally with a small quantity of alcohol, after which it may be dried and weighed—the basin being of course weighed before the operation was commenced. If the liquor has been filtered into a beaker, bend a piece of platinum foil (weighed) into a cylinder, and connect with the zinc pole, and allow a platinum wire from the other pole to dip into the centre, when the copper will be deposited on the cylinder.—D. Williams.

[52754.]—**Japanese Scintellelles.**—The compo. for the above is very simple and cheap: it is a mixture of sulphur, nitre, and lamp black (all commercial quality). I have not the proportions really to hand, but the querist can try for himself, putting sulphur most, and so on. But he will find that it is a very nice point to get it right, as I know to my cost. A grain or two, more or less, of lamp-black will make all the difference in an ounce of compo. Put about 3gr. of successful compo. in tissue paper, V-shaped, 4in. long and 1in. at base and twist up.—P. Ward.

[52755.]—**Lathe Bed.**—Certainly you can cut out the gap in the pattern, in which case your print *a a*, Fig. 1, on page 326, must be cut off flush with the bridges that bound the gap, and the core box, Fig. 5, omitted altogether. It seems strange to me that a moulder should object to cores, since they save him a deal of trouble, and minimise the risk of "wasters." However, it is no good to cut up rough; we have to humour these gentlemen sometimes, much against our will. Dresden is not Berlin or Manchester, so you must do as they do in Dresden. The core boxes open by drawing the sides away from the ends, said sides being secured to ends during ramming up by means of screws. See annexed figures, which represent one end of a core box screwed up, and same end taken apart. The rebated grooves may be ⅛in. or ¼in. deep.—J. H.



[52763.]—**Violin Measurement.**—"Otto on the Violin," Cocks and Co., New Burlington-street, will give R. G. Price the measurements of violins, and a description of the old Cremona instruments.—E. E.

[52763.]—**Violin Measurement.**—I would refer you to Mr. Davidson's work on the violin, and a more recent work on the violin, by Mr. Fleming, published at the *Bazaar* office. These contain the mystery so far as known, and also the history of the violin.—A. Howland.

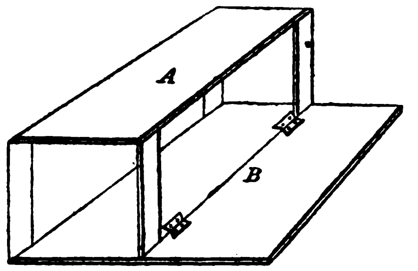
[52765.]—**Preventing Sparks in Contacts.**—"Cowper" will find that if he attaches a small condenser (made of about six sheets of tinfoil 4in. by 6in.) to each side of his contacts, he will not be troubled by what is really the "extra current" eating up his platinum; or he may use a copper or brass wire pin dipping into mercury, and dispense with condenser.—P. Ward.

[52765.]—**Sparking in Contact Breakers.**—Use one of following methods:—1. Shunt your electro-magnet with very fine high-resistance wire, winding the shunt half right-hand and half left-handed, making it at least 40 times the resistance of the electro-magnet. 2. Use a small condenser ¼ microfarad between the terminals of your electro-magnet. 3. Add a large resistance to circuit, and increase battery power till current is same as before. Cosmos.

[52765.]—**Prevention against Sparking in Electrical Contact Breakers.**—I have to thank

"Sigma" for his suggestions in this week's English Mechanic as to prevention of sparking; but one point is not clear to me. He says: "Wind outside the magnet coils another circuit of high resistance, with its ends soldered to those of the magnet wire as a shunt." Let me ask if he means that the outside wire of the resistance coil is to be soldered to the outside magnet coil wire, and the inside wires of the two coils to be similarly connected? Or does he mean that the two ends of the resistance wire shall be joined, say, to either of the outer or inner wires in such a manner that the current passes before (or after, as the case may be) it traverses the magnet coil? If the latter mode of connection, cannot the resistance coil be so arranged as to be quite near the battery, instead of being wound round the magnet coils, as in my apparatus I have eight electro-magnets and eight breakers—only working, however, one at a time. I am, therefore, anxious, if possible, in order to save trouble and expense, that one resistance coil should serve to prevent the sparking in the whole of the circuits. Would "Sigma" kindly insert a small diagram explaining mode of connection in next issue? As for Mr. Bennett's suggestion, that there must be something wrong with my platinum, I think if he uses a current with E.M.F. of 10 volts 2 ampères, with two or three ohms external resistance, he will find a considerable spark on breaking the circuit, with any quantity of platinum.—Cowper.

[52766.]—**Magic Lanterns.**—The best position for oil or oxy-calcium lamp lanterns, giving most of the advantages of a biunial, is obtained by using a stand as below, A and B being the position of the lanterns. It may be made to fold up if thought desirable. The distance between the two tables is just sufficient to allow slides to pass under the upper one; the lanterns may be manipulated from one side, which is a great advantage.—A. B. Cotton.



[52778.]—**Registration of Slides.**—*Perfect* registration can be effected only by having side stops on the left-hand side of the lanterns, and by adjusting the lower and left-hand side of every carrier with the smoothing plane, or slips of wood glued on, as need may require, until with previous registration of lanterns a dead shot is obtained. A good makeshift, and perhaps a better plan for chromatropes, as the handle may then project either side, is a central saw-cut groove, ⅛in. wide and deep, across the lower edge of carrier, which engages a pin, a fixture, also central and projecting slightly above the bed on which the carrier when in position rests. The carrier drops readily into its place, and for most purposes this plan answers well. If "Fred" wishes for it, I can send him patterns of home-made carrier, which all who have tried it prefer to any other. Either side of unframed slide is centred and released with absolute certainty, and perfect ease.—A. B. Cotton, Hartly, Alton, Hants.

[52780.]—**Bath Heater.**—W. B. Bousfield states that he has fitted a number of baths to heat 45 gallons from 60° to upwards of 90° in 4 to 7 minutes. Our water is always between 40° and 50° in winter, and we want it at 98° or thereabouts. This, in proportion, will reduce the 45 gallons to about 25. He states that the cost of gas is about 2d. for each bath. Taking the gas at 3s. 4d. per 1,000, this means 50 cubic feet, which, if burnt in 4 minutes, requires a supply of 750 cubic feet per hour to the burner. This would require a 120-light meter and, say, a 3in. service main. Not many people would go to the expense of a special main, a meter large enough for a factory, and other things in proportion, simply to heat a bath in 4 minutes. We have a 60-light meter and a 2in. service, and cannot get at most over 300ft. per hour = 20 cubic feet in 4 minutes—less than half what W. Bousfield states to be necessary. No doubt what he states is possible; but for one who would go to such an expense there are thousands who certainly would not.—An Old Subscriber.

[52781.]—**Battery for Lamp.**—"Sigma" seems rather to misunderstand my query. I was not seeking information as to the cost, for I shall probably find that out myself. If "Sigma" will compare my letter, No. 52781, with that of "Presto et Presto" and "E. F. F.," No. 50290, in the issue of May 11th, 1883, he will probably notice the difference in the times that our respective batteries continue in action. "Presto et Presto" says, "I find that my battery requires recharging every six or eight weeks." Now here's the rub, for mine requires recharging every six or eight hours, instead of weeks. If "Presto et Presto" and "E. F. F." are still subscribers I should like to hear their opinion on the subject. Now, supposing I were to enlarge my jars from 6in. to 10in., should I get a light for a greater length of time? There is also another wrinkle I should like. I notice that after the battery has been in action about four hours, and I lift out one of the zincs, I find it covered with a thick deposit very much like mud; the liquid in the porous jars also becomes the same colour as that in the outer jars. What is the cause of this? Is it owing to the muriatic acid which I put into the porous jar, or is it the solution in the outer jar that finds its way through the porous pot?—Robert S. Hargreaves.

[52783.]—**Phenylendiamine.**—To separate any of the three phenylen diamines from tin, precipitate the latter with sulphuretted hydrogen. Iron or zinc chlorides may be removed by adding milk of lime or baryta water, and filtering; or they may be precipitated by sodium carbonate.—Organic Chemist.

[52792.]—**Steam Launch.**—How will this do? A A A in Fig. 1 is the stem, keel, and shaft post, B is the rudder post; all three are mortised in the keel; stem, 4ft. long, 4in. broad, and 2in. thick; shaft post, 3ft. 6in. long, 5in. broad, 2in. thick; except where propeller goes through, it must be left thick enough to allow a hole large enough for bush and gland; J is shaft with flange to connect to engine, which should not be less than 1½in. thick; rudder post 3ft. 7in. long, 3in. broad and 2in. thick, which is shown in Fig. 2, marked 5. It will be seen rudder post is made narrow behind where broad mark is shown, to allow rudder to move freely from side to side. H H are small eyebolts for rudder to hook on; F is rudder, 12in. broad and 1in. thick, of any hard wood; 4 is shaft post, with tenon at bottom, for mortising in keel, and bush in with gland studs, for nuts to screw on to nip gland up for packing; 11 is hard wood board, 1in. thick, about 12in. long, to fit on rudder head to steer with; 1 shows top view of boat; V shows shaft-post just level with short piece of deck; R is rudder head, which must stand 6in. higher; 9 and 10 is cast-iron bush and gland; *c c* are two pieces of hard wood spiked on keel, and to stem and shaft post, for strength; those marked D are the ribs, 1in. broad by 3¼ thick—can be ash, but American elm is best: it is a very tough and stringy wood, and not liable to break when bending; 6 and 7 in Fig. 2 will show about what shape the ribs look at each end of boat and the middle; 8 8 are bits of inch board, edge up, fitted in boat bottom for floor to nail to—about twelve of them; the broad mark down stem, shaft post, and along keel is a groove nearly V shape; K will show the groove—it shows the end view of keel. The bits at each end of keel must not be cut off until after the mortising is finished and post driven in. Keel is 20ft. long, there is 8in. of space between shaft and rudder post for propeller to work in, so shaft will have to be drawn back a bit to allow propeller to go on, Propeller should be about 24in. diameter; 2, in Fig. 2, shows the first plank that must go on, which is nailed to the groove in the keel; then all the rest will be shape of the 2 board marked, 3 showing how they lap over each other about 1in. The planks should be elm, if you could afford it: white wood will do, but not near so well—they will be liable to split when springing them in their place, and nailing them on. The nail is wrought iron, with small washers with them, made on purpose for boats.

Fig. 1.

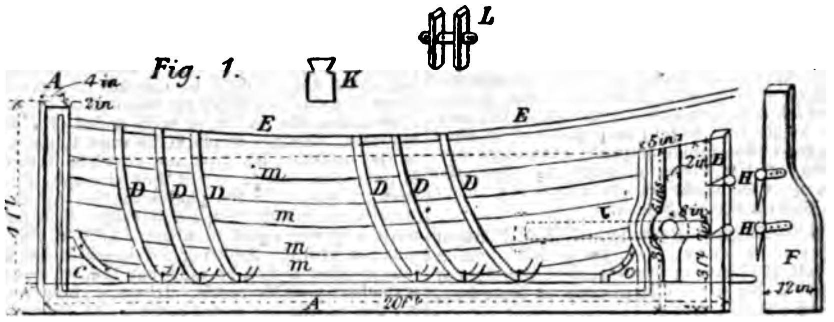
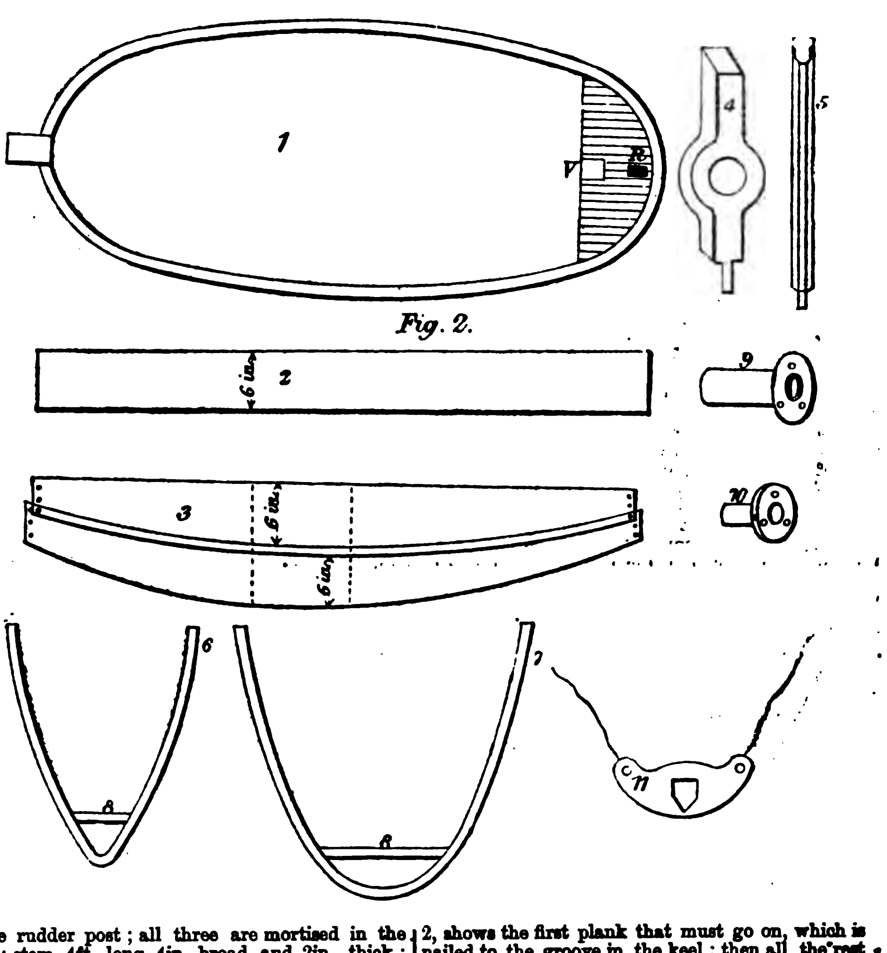


Fig. 2.



Some use copper nails and washers, but they are dear. Whatever width you bend your middle ribs will be the width of boat: they are spiked to the keel as in Fig. 1; then nail about 4 hardwood laths to the inside of ribs, from stem to stern, at each side of the boat, and at equal distances apart, to strengthen framework, and, as lines to go by, when laying the planks on as shown in Fig 1, *m m m m*. The planks should be ½in. thick, and are held in their place while you nail them to the ribs, with the clamps L in Fig. 1; they are easily made: two bits of hard wood, 10in. long, 2in. broad, and 1in. thick, with a piece of wood put through two slits in them and a pin at each side. Bottom part is clasped on the rib and planed and a wood wedge driven in the top. You will want twelve of them to hold the plank close to the ribs all the length, while nailing them. Treat the next plank the same. A launch this length, and 6ft. broad, and made like this, will be strong and plenty small enough and quite safe. It will not cost such a deal if you make it yourself. I will help you all I can if you make it. Living at a seaport, I see a deal of launches. Do not make it less than shown. It puts me in pain when I see a boat too small, wallowing in the river with several people in, and nearly down to the water's edge. I will freely lend you two patterns for the bush and the gland to be cast from; and if you advertise your address, I will give you the size of a suitable engine next that will not cost much.—Thomas Thompson.

[52783.] — **Phenylendiamine.** —There are three varieties of this base—viz., ortho., meta. and para. The first of them may be obtained by acting on orthonitrobromobenzene with ammonia, which produces orthonitraniline, and on reducing this with tin and hydrochloric acid, orthophenylenediamine is obtained. This base forms a sulphate which is easily soluble in hot water, but only slightly so in cold water; and possibly by converting the amine into a sulphate, advantage may be taken of the above property to effect the separation for which the querist asks.—Wm. John Grey, Elswick Science School.

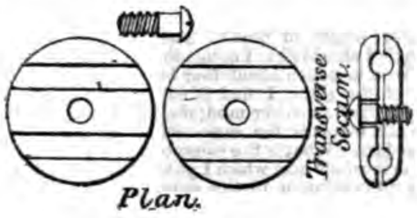
[52785.]—**Hughes Battery.**—1. E.M.F. about 1·0, int. res. 7w. or 8w. Int. res. is dependent on size of cell, thickness of sawdust, and tightness of packing. 2. No use. Use granule or some form of bichromate.—Cosmos.

[52789.]—**Watch Repairing.**—Take the watch all to pieces, take up the balance, and with a sharp knife take off the collet with the pendulum spring attached. Examine the pivots; carefully run it in the calipers to see if the pivots are quite straight. If found to be bent, take a common pliers and bend them gently. These pivots are not very hard, so there is not much fear of breaking them unless very much bent. Then see if the pivots are getting flat on the points; if so, they must be done up again in a pivoting tool nice and round on the points: then put it in the plate-screw, the cock down, and see if it is quite free between the jewel-holes; see that the end stones are sound—if not, put new ones. The cylinder must be quite free upon both ends. Then examine the scapewheel, run it in the calipers and see if it is quite flat; if not, it must be made flat. Put the 'scapewheel in the plate, give it a very little end shake, see that it runs free on both ends, especially on the end next to the bar, as the teeth sometimes strike the inside of the bar, which must be corrected; if so, then place the cylinder in the plate along with 'scapewheel; get the 'scapeteeth to strike the centre of notch in cylinder (not too high or too low), if too low, the back of the 'scapewheel would strike the bottom of cylinder, or if too high the notch of cylinder would strike the flat of 'scapewheel (which we often see by the 'scapewheel recoiling at every beat of watch) which must be avoided. If you put these things correct and the rest of watch be all right, you will have a good going Geneva watch.—Casper Hauser.

[52794.]—**Toning Prints.**—If "Vango" will try the following, I think he will succeed:—Take a 15gr. tube of gold chloride and put 15oz. of water to it. Then to tone the prints, which should be printed until the light parts begin to go slightly brown, take 10oz. of water and dissolve in it 50gr. of borax, then add ½oz. of the gold solution; then proceed to tone the prints, having previously well washed them. The above amount will tone from 16 to 20 prints. After toning, treat with hypo in the usual way. The borax solution must be always mixed when wanted—never before.—C. L. Tweedale.

[52794.]—**Toning Prints.**—"Vango" should wash his prints in three or four different waters. The last washing should leave the water perfectly clear; next put the washed prints into the following solution:—Chloride of gold, 1 grain; acetate of soda, 30 grains; distilled water, 6oz. The prints should be allowed to remain in the toning solution till the red colour has changed to a warm sepia, or darker if required. The prints should be moved about a little to produce equality of tone. Now wash the prints for a minute and immerse in hyposulphite of soda, 2½oz.; water, 10oz., for five minutes. Now wash the prints in running water for several hours; dry and mount.—Photographicus.

[52797.]—**Joining Electric Wires.**—It is quite possible to make thoroughly good joints without soldering, but I doubt if a good level joint could be made without. Doubtless what the engineer had in his mind was a most efficient and beautifully simple joint used by Crompton, as per sketch.—P. Ward.



[52798.]—**Lalande Element.**—A full account of this element may be seen in *Electrical Review*, July 28th, and an analysis of the working in the same journal for Aug. 11th of last year. The elements are caustic potash, cupric oxide, and zinc.—Cosmos.

[52807.]—**Power for Circular Saw.**—"Shadowless Man" cannot hope by any arrangement whatever to get more than about 1¾ h.p. from his piping. Supposing the pipes to be in proper working order, they should be capable of delivering about 57 gallons of water per minute at a height of 125ft. above the outlet, or with a fall of 75ft. in the mile. In other words, if he were to put a tap on the outlet of his pipe, and regulate it so that 57 gallons a minute would flow through, then a pressure gauge on the pipe near the tap should show a remaining pressure of 125ft. This represents a power equal to about 72,000 ft.-lb. per min., or 2¼ h.p. Allowing for losses in the turbine or other motor, he must say 1¾ h.p., and this is the best possible result. In order, however, to get this result, his motor must be so constructed that it will use the 57 gallons per min. fully open to the pressure of the water in the pipe without any throttling or obstruction. If it uses much more or much less, the power will be reduced. If so small a power would be of any use, I believe a suitably-constructed oscillating water engine would be more effective than a turbine. A waterwheel would be of no use unless it were made 125ft. diameter. An efficient air valve should be put on each of the high places of the pipe.—W. Wyatt.

[52811.]—**How to Cause Tar to Dry Quickly.**—Boil the tar for two hours, and when it has again cooled, add, with stirring, benzoline until of proper working consistency. The boiling should be done in the open air, to escape from the unpleasant vapours given off and the risk of fire from the tar boiling over, and in a vessel of sufficient capacity to contain two or three times the quantity of tar operated on.—Gas Manager.

[52812.]—**How to Cause Tar to Dry Quickly.**—I think if you mix turps carefully with your coal-tar you will succeed. Not too much turps, or the tar will be lumpy, and will not mix.—J. B.

[52816.]—**L. and S.W. Engines.**—I regret to say I have not full dimensions of the new bogie-engines on this line (Nos. 445—454). They are somewhat similar in appearance to the 137 class by Beyer, Peacock, and Co. The 445 class have 7ft. coupled wheels, and cylinders 18in. by 24in. (outside).—Meteor.

[52817.]—**S.E.R. Engines.**—Dimensions, and a small sketch of the 81 class appeared a little time ago in the "E. M." The driving wheels (single) are 7ft., and cylinders 16in. by 22in.—Meteor.

[52817.] — **S.E.R. Engines.**—No. 81 class: cylinders 16in. by 22in., driving-wheels 7ft. dia., leading-wheels 4ft. 6in., trailing-wheels 3ft. 9in., and weight about 34 tons. No. 81 was built at Ashford by Mr. Cudworth, and renewed in 1877, by Mr. Watkin. It is fitted with the vacuum brake.—F. W. Brewer.

[52817.]—**S.E.Ry.**—The 7ft. singles, such as 81, &c., were built, some by the company at Ashford, others by the Vulcan Engine Co. of Warrington, about 15 to 20 years ago. Cylinders 16 by 22, grate area (Cudworth's firebox) about 21 square feet, heating of firebox 132¼ sq. ft., of tubes 973 sq. ft. Diameter of leaders 4ft. 6in., of drivers 7ft., trailers 3ft. 9in. Weight on leaders 10 tons 6cwt., on drivers 12 tons 9cwt., on trailers 9 tons. Total weight, 31 tons 15cwt. The engines have double frames, and a wheel base of 17ft. 3in., and are, therefore, rather bad to get round curves. Many have now been rebuilt.—W. B. P.

[52820.]—**Lickey Incline.**—The best account of the American engines used at one time for working this incline is to be found in Dempsey's "Locomotive Engines," Weale's series. The bank is 2¼ miles long, quite straight, and rises 1 in 37 from Bromsgrove to Blackwell.—W. B. P.

[52820.]—**Lickey Incline.**—I scarcely think the querist is correct in saying an American engine draws the trains up this incline, because the Bromsgrove Railway Works are held by the Midland Railway Co., and in addition to the works are three engine sheds, appropriated to the locomotives working the incline, which has a gradient of 1 in 37 (or 37½); it is 2¼ miles in length, and the trains ascend at the rate of 8 to 9 miles an hour.—A Member of the Society of Engineers.

[52820.]—**Lickey Incline.**—The gradient of this line is 1 in 37. I have not the length by me at present, but will send soon. There were 12 American engines built for this line by Norris, of Philadelphia, 1840: Outside cylinders, 10½ by 18; single pair of driving wheels, 4ft. dia.; 4-wheeled truck, wheels 2ft. 6in. dia.; 78 copper tubes, 2in. dia., 8ft. long, weight 9tons 11cwt. 1qr. With the Editor's permission I will send a sketch of one of these American engines, as I believe it will be interesting, also a few of their performances. I would send them now, but have not got them by me at the present moment. The Lickey incline was afterwards worked by 6-coupled goods engines (M.R. 350 class, Kitson, 1855), and in 1861 four well-tank engines (double frames); Nos. 220—223 were built specially for this traffic. These had 6-coupled wheels, 4ft. dia., and cylinders 16½ by 24. The Lickey is now worked by Johnson's side tanks, 6-coupled 4ft. 6in. wheels; cylinders 18 by 24. Meteor.

[52821.]—**N.E.R. Engines.**—The following are the dimensions of the new bogie engines building at Gateshead: Cylinders, 17 by 24; bogie wheels, 3ft.; coupled wheels, 6ft. 7in.; wheel base, bogie, 5ft. 3in.; wheel base bogie pin to driving wheel, 9ft. 7in.; wheel base coupled wheels, 8ft. 4in.; boiler dia., 4ft. 1in.; length 10ft. 2¾in.; 190 tubes, 1¾in. dia.; length of firebox, 5ft. 6in.; heating-surface, firebox, 100 sq. ft.; tubes, 913·8 sq. ft.; total, 1013·8. The engines are to be built from Mr. McDonnell's designs, for the express trains between York and Edinburgh.—Meteor.

[52827.]—**Ramsbottom's Scoop for Locomotives.**—"Feed-Pump" is quite correct in his interpretation of the formula. But he must remember that, with a pipe of uniform dia., the column of 52·25ft. will just balance the effort of the water to ascend, and there will be no flow or discharge. If he cuts one foot off the top of his pipe, he will have an 8ft. per second flow; if two feet be cut off, an 11·3137ft. per second flow, and so on. Further, he must allow for loss through bend in his pipe; say, for a quarter bend, he would have an 8ft. per second discharge at 51·25 / 1·5708ft. and an 11·3137ft. per second discharge at 50·25 / 1·5708ft. A small further allowance should be made for viscosity (commonly called "friction").—G. Pinnington.

[52829.]—**Manchester and London Expresses.**—Although I take great interest in all relating to matters like the above, yet I fear my views on the query would not be of much service, and I always try to keep in remembrance the extract from Montaigne at the beginning of the Correspondence columns.—Wm. John Grey, Elswick Science School.

[52830.]—**Coal-Burning Locomotives on M. Ry.**—The two goods engines built by Beyer, Peacock, and Co., in 1858, for coal-burning, had Cudworth's sloping firebox, which is still in use in many engines on the S.E.R. The box is generally 7ft. 9in. long, and is divided by a longitudinal mid-feather, the two valves being fired alternately to prevent smoke. The trailing wheels are got in under the back part of the box, owing to the slope. The engines in question were 16in. 5ft. double-framed goods, were numbered 428 and 429, and were tried for a year against two other goods engines of the same class, Nos. 426 and 427, built at Derby. These had plain boxes, without brick arch or deflector. The Cudworths burnt somewhat less coal, and that of a poorer kind, but the saving did not pay for the cost of the system. Nos. 426 and 427 were then fitted with a brick arch or deflector, and another year's trial was made, resulting in a great victory for the latter plan. 428 burst at Nottingham; she and 429 were rebuilt with ordinary fireboxes, and were running in 1877, and may be still.—W. B. P.

[52835.]—**Cometary Orbits.**—The method of calculating these is very fully explained in a "Treatise on Comets," by David Milne, published in 1828. I fear it is almost impossible to give a useful abstract within reasonable limits; but if the querist cannot obtain the book, might try to do so. The calculation is long and awkward in the extreme, but highly interesting, the work of finding one of the elements being especially so.—Wm. John Grey, Elswick Science School.

[52840.]—**Core Box for Globe Valves.**—Before occupying the inquiry columns with several sketches and descriptive matter, I should like to be certain as to the exact kind of valve meant. Is it, as I presume, one of a type common as regards internal shape, alike to steam, escape, and check-valves, in which the fluid coming along the entering tube passes up (or down) a pierced diaphragm, occupied with a lift valve in the centre of the globe, and onward through the exit branch—the face of the diaphragm and its valve lying parallel with the longitudinal axis of the cock, and in the same plane as the hand wheel, if a steam valve? My MECHANICS begin with Vol. XXXI., so I cannot refer to the article you mention. If, however, this is the kind of valve meant, it is not an easy job, except for a patternmaker. Please let me know whether my supposition is correct, and I will contrive to make the matter clear. I have such a valve roughly outlined among "Papers on Pattern Making," and will, if the right thing, give it you in these columns.—J. H.

[52843.]—**Dynamo Making.**—I do not advise you to make such a small machine as you propose, on account of the high speed you are obliged to drive them (3,000 per minute), and also the heat generated if kept running for more than a quarter of an hour. If you have power to drive it, I should recommend you to make one with an armature from 4in. to 6in. diameter. It is impossible to give you an answer to your query as to size of wire, as you do not say if you want it for lighting or plating. Weight for weight, you would have more power in the wrought iron (F. M.'s); but I don't think it would compensate you for the extra expense that wrought iron would incur over cast iron. You had better make a full-sized sketch of the proposed machine, with the legs 8in. long by ½in. thick and see how it looks. About 12 B.W.G., double cotton-covered, will do for the F.M.'s, and about five layers of it; size on armature will depend on what you want it for.—VOLT.

[52846.]—**London Univ. 1st B.A.**—

$$\text{Let } \sin.^{-1}\frac{5}{x} = \text{A}.$$

$$\sin.^{-1}\frac{12}{x} = \text{B}.$$

Then, since their sum $= \frac{\pi}{2}$ they are complementary angles.

$$\therefore\ \sin.\,\text{A} = \cos.\,\text{B} = \frac{5}{x},$$

$$\sin.\,\text{B} = \cos.\,\text{A} = \frac{12}{x},$$

$$\text{and } \sin.\,(\text{A}+\text{B}) = \frac{5}{x} \times \frac{5}{x} + \frac{12}{x} \times \frac{12}{x} = 1$$

$$\text{whence, } \frac{25}{x^2} + \frac{144}{x^4} = 1,$$

$$\text{and } x = 13.$$

If the sines be calculated with this value of x, the angles will be found to be 22° 37′ 11·5″ and 69° 22′ 48·5″, their sum being 90°.—H. T. V.

[52846.]—**Lond. Univ. 1st B.A.**—Many questions in inverse notation are best solved by changing into ordinary notation, thus:—

$$\text{Assume } \sin.^{-1}\frac{5}{x} = a,\ \sin.^{-1}\frac{12}{x} = b,$$

$$\text{Then } a + b = \frac{\pi}{2},\ \therefore \sin.\,a = \cos.\,b;$$

$$\text{Also } \frac{5}{x} = \sin.\,a\ \frac{12}{x} = \sin.\,b;$$

$$\therefore \frac{5}{x} = \cos.\,b$$

$$\frac{12}{x} \div \frac{5}{x} = \frac{\sin.\,b}{\cos.\,b} = \tan.\,b;$$

$$\text{That is, } \tfrac{12}{5} = \tan.\,b\ \ \therefore \sin.\,b = \tfrac{12}{13};$$

$$\text{But } \frac{12}{x} \sin.\,b.\ \ \therefore \frac{13}{x} = \tfrac{12}{13}.$$

$$\therefore x = 13.$$

—JOHN F. WILKINSON, A.R.S.M.

[52847.]—**Co-ordinate Geometry.**—Let A x + B y + C = o; cut the axis of x and y in K and L, and let P be f, g, and PN the ⊥ on the line LK. Then:—

$$\triangle\text{PLK} = \triangle\text{POK} + \triangle\text{PLO} - \triangle\text{LOK}$$

$$\therefore \text{PN}\,.\,\text{LK} = \text{OK}\,g, \sin.\,w + \text{OL}\,f, \sin w - \text{OK.OL}\ \sin.\,w\ (1)$$

$$\text{Now OK} = -\frac{\text{C}}{\text{A}},\ \ \text{OL} = -\frac{\text{C}}{\text{B}}$$

$$\text{Also LK}^2 = \text{OK}^2 + \text{OL}^2 - 2\text{OK}\,.\,\text{OL}\cos.\,w$$

$$= \frac{\text{C}^2}{\text{A}^2\,.\,\text{B}^2}(\text{A}^2 + \text{B}^2 - 2\text{AB}\cos.\,w)$$

$$\text{From (1) PN} = \frac{\text{B}g + \text{A}f + \text{C}}{\sqrt{\text{A}^2 + \text{B}^2 - 2\text{AB}\cos.\,w}}\sin.\,w$$

$$= \frac{-8 + 12 - 7}{\sqrt{16 + 4 - 8}}.\ \sqrt{\frac{3}{2}} = -\tfrac{3}{4}$$

—H. H. HARRISS.

[52849.]—**Gas Consumption.**—If "An Old Subscriber" has old and leaky pipes and fittings, his meter will certainly register less if turned off when not in use. He can very easily have his fittings tested by sending to the gas works from whence he is supplied, asking to have his fittings tested. This can be done in five minutes by a force-pump. If faulty, it is worth the trouble to find the leaky place and repair it, as any leakage goes on constantly whilst the meter is turned on, whether the lights are used or not.—T. F.

[52853.]—**Engine Power.**—I am afraid I shall not be able to show "Sammy" in plain figures how to obtain the hyp. log. of his engine—or, more plainly, the number of expansions in the cylinder from the point of cut-off. If "Sammy" will get one of the Irish "Arithmetics" in use in the Irish National Schools, he will find a table of numbers brought into common log., and then multiply by 2·3026 to change into a hyp. log., he will be able to make his own. So if you divide the length of stroke by the distance the piston has travelled when the steam is cut off, you will get the number of expansions, or 45in. ÷ by 26in. = 1·73 expansions; and by looking at the table that I gave to "Anxious One," you will find that the nearest hyp. log. to 1·73 expansions is ·560 plus 1; so I should work with that log. to find the average pressure. I think the inspector informed you wrong when he told you that the boiler pressure was same as engine; as there must be a greater pressure in boiler to get an average pressure of 27lb. in cylinder with the cut-off as given. Of course, I am reckoning from pure vacuum line; so if you look at the steam gauge, and add 15lb. for atmosphere, and multiply the terminal pressure in cylinder by the hyp. log. ·560 plus 1, and deduct the back pressure in condenser, you will get the average pressure in cylinders, and proceed by the information given in back numbers to find the horse-power.—FIRER, Dewsbury.

[52859.]—**Electricity and Steam.**—The effects are due to static electricity generated by the friction of the passing steam. For a full account of this phenomenon, and a description of the Polytechnic Inst. engine constructed, for investigation into it, see Bakewell's "Electric Science," page 92; edition of 1853.—COSMOS.

[52862.]—**Chemical Problems.**—The 851·4 volumes of air at 537·4mm., and 4° centigrade must be corrected to standard conditions for which we have—

$$v = \frac{851{\cdot}4 \times 537{\cdot}4 \times 273}{760 \times 277} = \frac{124909064{\cdot}28}{210520} = 593{\cdot}3.$$

The volume which disappeared on explosion is 657·06 − 374·73 = 282·33, one-third of which, or 94·11 is oxygen. Hence we have—

$$593{\cdot}3 : 94{\cdot}11 :: 100 : x$$

and—

$$x = \frac{9411}{593{\cdot}3} = 15{\cdot}86 \text{ per cent.} \therefore \text{N} = 84{\cdot}14 \text{ per cent.}$$

It seems to be rather curious air. The second question is apparently from Lupton's book, the data being divided by 2. Taking strontium to be a diad, and denoting its atomic weight by x, the molecular weight of the crystallised chloride is evidently 179 + x; and the molecular weight of the sulphate is 96 + x. We therefore have—

$$\begin{aligned} 179 + x : 96 + x &:: 5 : 3{\cdot}442 \\ 616{\cdot}118 + 3{\cdot}442x &= 480 + 5x \\ 136{\cdot}118 &= 1{\cdot}588x \\ 87{\cdot}36 &= x. \end{aligned}$$

Of course the accuracy of this result depends entirely on our correctness as to the formula of the chloride and sulphate, and if strontium is taken as monad or triad, we will get a different number for x. The best criterion of the atomic weight is that derived from Dulong's law respecting specific heat, with which, doubtless, the querist is familiar. I cannot, however, find that there has been any determination made of the specific heat of Sr, so we must fall back on somewhat indirect evidence. The sp. ht. of calcium is ·167, and therefore its atomic weight is 40, and it is a diad, and looking to the strict analogy between Ca, Sr, and Ba, which metals form an exceedingly well-marked group, we are led to conclude that Sr is diadic. Again, the sp. ht. of $SrCl_2$ is ·1199, and this also favours the view of the molecule containing three atoms. It is, of course, impossible fully to discuss all the facts bearing on the atomic weight assigned to a metal, within the limits of a reply to query; and I have merely given an outline. The querist will find it most interesting and instructive to study the points of analogy in the alkaline earth's group. The next question is merely one of arithmetic. The ash left by a piece of filter paper 60 centimetres square is ·1062 gram. Therefore, one square centimetre will leave

$$\frac{{\cdot}1062}{3600} \text{ grm.}$$

The filter paper of 5cm. radius will have an area of 78·54 square centimetres (the area of a circle being equal to πr^2). The weight of its ash will therefore be—

$$= \frac{{\cdot}1062 \times 78{\cdot}54}{3600} = {\cdot}00231\text{grm.}$$

The querist can calculate the ash from the other sizes given. This question is No. 19 in Thorpe's book. In the last question, which is No. 161 in the aforesaid book, let x denote the atomic weight of carbon; then, for acetate of silver, we have—

$$143 + 2x : 108 :: 28{\cdot}803 : 18{\cdot}612.$$

$$\begin{aligned} 2661{\cdot}516 + 37{\cdot}224x &= 3110{\cdot}724 \\ 37{\cdot}224x &= 449{\cdot}208 \\ x &= 12{\cdot}067. \end{aligned}$$

For tartrate of silver, we have—

$$316 + 4x : 216 :: 16{\cdot}22 : 9{\cdot}6175.$$

$$\begin{aligned} 3\qquad 3039{\cdot}13 + 38{\cdot}47x &= 3503{\cdot}52 \\ 38{\cdot}47x &= 464{\cdot}39 \\ x &= 12{\cdot}071. \end{aligned}$$

For malate of silver, we have—

$$300 + 4x : 216 :: 25{\cdot}898 : 16{\cdot}059.$$

$$\begin{aligned} 4817{\cdot}7 + 64{\cdot}236x &= 5594{\cdot}148 \\ 64{\cdot}236x &= 776{\cdot}448 \\ x &= 12{\cdot}087. \end{aligned}$$

My answers do not exactly agree with those in Thorpe, because I have used the nearest integer for the atomic weight of silver, and Thorpe gives 107·93 as the more correct value.—WM. JOHN GREY, Elswick Science Schools.

[52865.]—**Barrel Organ.**—I should advise the querist to have two 4-octave sets of reeds of F scale, one of 8ft. pitch, and the other set 4ft. The best plan perhaps to adopt would be to purchase an ordinary 2-row tubeboard and reeds, and cut off the lower octave of each row. He can have the whole five octaves, if that would not be too much; but I suppose that would eventually be too clumsy for him. However, he must use his own judgment in this case. As regards the bellows, it makes no difference whether it is placed vertical or horizontal, except for consideration of space. The power or pressure of wind depends greatly on the power of the spring which is placed inside reservoir.—G. FRYER.

[52867.]—**Feed Pump.**—There are various ways of finding the amount of water your pump will force into the boiler. The simplest rule that I know, in my opinion, is to square the diameter of pump barrel in inches, multiply by ·034, and by the length of stroke in feet, and by the number of strokes per minute, or thus:—

$$\begin{array}{rl} 2{\cdot}25 & \text{dia. of pump} \\ 2{\cdot}25 & \\ \hline 1125 & \\ 450 & \\ 450 & \\ \hline 5{\cdot}0625 & \\ {\cdot}034 & \\ \hline 202500 & \\ 151875 & \\ \hline {\cdot}1721250 & \\ 3 & \text{ft. stroke} \\ \hline {\cdot}5163750 & \\ 45 & \\ \hline 25818750 & \\ 20655000 & \\ \hline 23{\cdot}2368750 & \text{gal. per min.} \end{array}$$

Call it 23¼ gallons, providing the pump was full every stroke.—FIRER, Dewsbury.

[52870.]—**Zinc Organ Pipes.**—These pipes are generally tuned by the cones; but some of the metal organ pipes are tuned by a small piece of sliding metal situated at the top of the pipe. In the latter case the pitch is sharpened by raising the metal, and flattened by slightly pressing it downwards over top of pipe. In using the cones for the zinc pipes, to sharpen the pitch, it is necessary to insert the solid cone in the pipe at the top, and by a slight pressure on the cone the pipe is sharpened. To flatten, the hollow cone is placed over the top of the pipe, and being slightly pressed, brings a small portion of the metal over the top of the pipe, which has the desired effect. Great care is required in tuning the organ, and some degree of skill is required in using the cones. Not having made any organ pipes, either metal or wood, I am unable to furnish any further information which is required by the querist; but I know that some valuable information will be found on the subject in some of the early volumes of our "E. M." I take this opportunity of asking some of our organ-building correspondents to furnish instructions how to make paper pipes. When properly made, they produce an excellent quality of tone, and as this information has never once appeared in the "E. M.," I should be exceedingly obliged if someone who is able will kindly send the information for the benefit of some of our musical readers.—G. FRYER.

UNANSWERED QUERIES.

◆

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Volt" has replied to 52473.

[illegible]. Leclanché Battery, p. 272.
[illegible] Screw Press, 273.
[illegible] High Pressure Valves, 273.
[illegible] Iron Boxes, 273.
[illegible] Imitation Sealskin, 273.
[illegible]. Oxy and Dioxy. Benzenes, &c., 273.
[illegible] Telescope, 273.
[illegible]. Cooking Apparatus, 273

[illegible]. Double Chloride of Aluminium and Sodium, p. 351.
[illegible] Milling, 351.
[illegible]. Aluminium Sulphide, 352.
[illegible] Trusses, 352.
[illegible] Electro-magnets—Solenoids, 352.
[illegible] Swing Front v. Swing Back, 352.
[illegible] Photographic Rolling Machine, 352.

QUERIES.

◆

[[illegible].]—**Cough Cure.**—I got from the replies to queries in the "E. M." some time ago a cure for whooping-cough, which I gave to my two children with an effect so magical, that I am exceedingly grateful to the gentleman who sent it. I refer to the bromide of ammonium cure. They never had a severe fit after the administration of the first dose. And now will some kind reader of this, our highly-prized old friend, the "E.M.," please give a recipe for an ordinary cough—one that can be relied on? I keep a shop in a densely-populated place, and many a time my heart is pained to hear the poor people cough—that hard hollow cough which grates so on one's feelings. I want it to give away to those who are too poor to purchase, and to those who are able at cost price; so that the misery of a disease consequent on living in a cough-producing climate may be in some degree alleviated?—David, Belfast.

[[illegible].]—**Governors.**—To "Engineer," and Others.—I see some traction engines having large balls, say 4½in. diam., while others have balls only 2½in. diam. Please say what advantage have the large ones over the small ones, or vice versa?—Engine Driver.

[[illegible].]—**To "F.R.A.S."**—In a work published in 1882, entitled "The Heavenly Bodies," it is stated that Neptune possesses two moons, the second of which has been discovered within the last few months by Lassell. Apart from the fact that Mr. Lassell died in 1880, what authority is there for this statement? The work in question also contains some palpable errors which shake one's faith in its general reliability—e.g., Saturn is stated to have seven moons, Uranus six, and the axis of Mercury is said to be "7 degrees inclined to the plane of the equator, so that there must be a great inequality in the days and seasons"! If "F.R.A.S." has read this book, I should be glad to hear what he thinks of it, as it strikes me that the whole work is written by a man with a preconceived opinion, to which end he weaves in all his statements, without being a master of the subject on which he writes.—E. D.

[[illegible].]—**Battery, Chloride or Granule.**—I shall be obliged if some one will kindly inform me how to obtain a longer duration of power. I use for bells and telegraphs only. If I increase the chloride of zinc, it eats the zinc plates too quickly. If I substitute chloride of ammonium and muriatic acid, the E.M.F. expires in about a month (the ch. of zinc plan lasts three months). How should I increase the quantity of ammoniac or the acid? The cells are excellent for a month, and then expire very rapidly. Would there be any advantage in making the bichromate and acid solution of outer jar two parts acid to one part bichromate solution, now it is in the reverse proportion? I think I ought to say that the zincs are not affected much by the chloride of ammonium, yet plenty of current is generated for some weeks.—R. [illegible].

[[illegible].]—**Jet or Vulcanite?**—I have a quantity of the above that have gone brown. Will some of our friends inform me how to restore them to their original blackness and freshness?—J. B. P.

[[illegible].]—**Analysis of Coal Tar.**—Will some analyst kindly tell me how this is analysed on the small scale in a laboratory? What is usually determined, and how is it done? I know of no book giving that information, and shall be glad to hear if there is one published.—[illegible].

[[illegible].]—**Analysis of Oil Cake.**—Will any practical hand say what is usually estimated in making an analysis of the above, and how the constituents are separated? The title of any book giving that information will also be of value to me.—Augustus.

[[illegible].]—**Gas for Boiler.**—Many thanks for Thos. Fletcher's reply to my query. I see no reason why gas should not burn, the tube being 6in. in diam., because when I put a gas tube at beginning of boiler, the flame ran right along to the end of fire-box. But if solid fuel would be best, would you kindly tell me what form of grate, which, if any, &c., to have? as I have not been able to make a fire burn on the grate I now have.—[illegible].

[[illegible].]—**Leclanché Battery.**—Could some reader kindly tell me the chemical reactions of the Leclanché—the formation, chemical composition, and cause of the different crystals produced by working this cell, the white [illegible], and also long hairy crystals which [illegible] by rapid exhaustion? Also any good treatise, [illegible] on the above battery.—Iolanthe.

[52882.]—**Improving the Voice.**—Dr. Moffat lately delivered in Glasgow a lecture describing the benefits to be derived from the inhaling peroxide of hydrogen as a means of improving the voice. I should be glad if any one could tell me in what proportion the gases are mixed? what quantity should be inhaled at a time? and how long before it affects the voice?—Vox.

[52883.]—**Negative Plates for Battery.**—Will David Gilmore kindly tell me how he reduces gas-retort carbon to powder (which I find very difficult to do), or would soot or lampblack, which is pure carbon, I believe, answer the purpose as well?—W. E. H.

[52884.]—**Engine Query.**—Will any of our readers be kind enough to assist me out of a difficulty I am placed in? I have a 2h.p. engine driven from a boiler that is placed about a dozen yards away from it, and is placed about 6ft. lower. The steam pipe is underground, and passed through earthen pipes. I should be glad if some one will instruct me how to get rid of the condensed water, and prevent it passing through the engine?—Beta.

[52885.]—**Ancient Lights.**—Will some one who knows kindly state how near I may build in front of an "ancient light," and say a word or two on the law generally thereon?—Old Ploughman.

[52886.]—**Dynamo.**—Would "Sigma" kindly assist me in the following difficulty? I have made a small dynamo with a Siemens H armature 1¾in. by 5½in., wound with about 60 yards No. 22 c.-c. wire; field-magnets wound with 78 yards of No. 16 and 42 yards of No. 18 outside of the No. 16,—120 yards in all. I can get no spark from it when driving it at 1,800 revs. per min.; but by exciting the F.M. separately I can heat an incandescent lamp of 50 ohms resistance to redness. Is that a fair test for it, or not? Having made the armature with iron ends, will that have any serious effect on it, or is the resistance of F.M. too great, so as to render the action of armature useless? It works well as a motor.—Ignoramus.

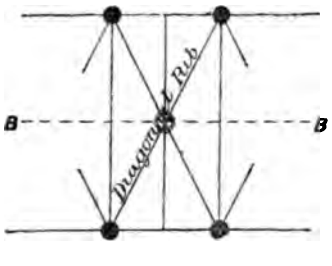
[52887.]—**The Clun Stone Circle.**—Will "F.R.A.S." kindly say if I should not rather look to the Precession of the Equinoxes for a cause of the change in the point of sunrise the gnomon connected with this circle would seem to indicate? In looking over Lyell's "Principles," I find he would divide the great cycle of 21,000 years into four quarters, and to the third quarter would give "long Arctic nights between lat 70° and the Pole, and short days with the sun at a moderate height above the horizon in all temperate latitudes." Then the point is, Would the sun in Neolithic times rise on the shortest day 8° further S. than at present? It seems to me that I have settled the date of this circle.—Neo.

[52888.]—**Induced Current.**—Will any one kindly enlighten me on the following?—On putting a galvanometer in circuit with secondary wire of small telephone induction coil, I find immediately a current is put through primary wire, needle is deflected. Does this show bad insulation of coil wires, or has an induced current magnetic power?—R. F. S.

[52889.]—**Induction Machine.**—Would some one kindly inform me, from personal experience, whether ebonite discs would be as efficient in Wimshurst's influence machine as glass, as I am afraid there would be a difficulty in obtaining the glass; and are these machines as efficient as a Voss with same size discs?—Electro.

[52890.]—**Lunar Queries.**—I am anxious to obtain a lunar cycle in which the moon will return to the same place on the same day, or very nearly so, with regard to the earth, and the same position relative to the sun. This, I believe, is called the Metonic Cycle. Would 1865 agree with 1884? I am aware that these positions would not agree with the distance of the moon or the cycle of her apogee and perigee. If there be any lunar cycle in which the moon returns to the same place with regard to the earth at the same time, with the same position relative to the sun, and also having the same distance from the earth, perhaps some of your correspondents, more learned than I, would tell me. Such a period has, I believe, never been calculated up to the present, if there be such a one in nature. What also is the relative difference of the orbit of the moon when in perigee and apogee? The moon is nearer the earth in perigee. What quantity would represent the difference from the point of her apogee?—George.

[52891.]—**Architectural.**—The sketch is the plan of a Gothic vault of any dimensions over one bay of the nave of a church. Will some one kindly inform me how to obtain the curve of the diagonal ribs in elevation when a section is taken, as shown by the dotted line B B?—Anxious.



[52892.]—**Polishing Paste.**—I should feel obliged if any of your readers could furnish me with a really good recipe for making metal polishing paste. I have seen a German preparation, a red pomatum, which does not harden and crack with keeping, and which produces a very good polish, particularly on brass.—Silver-Bright.

[52893.]—**Lantern Lenses.**—Having purchased a second-hand biunial lantern, I find that the lenses are single (one condenser and one object-glass) to each lantern. Will Mr. Laucaster or any friend tell me what the difference will be between this and one with double condensers and object-glasses? The cons. are 3¼, object-glass 1¾, and, strange to say, both cons. and object glass are achromatic.—Brum.

[52894.]—**Dynamo.**—To Mr. Bottone.—I thank you for the interest I now take in this, and anxiously look for your admirable articles. In an advertisement it is said to be 20-c.p. This is a technical term I do not understand. Would you oblige by giving the size of a room it would light fairly well?—Asta.

[52895.]—**Legal.**—Early in August last I electroplated a bracelet for a person living near me. When finished, I, knowing that they were not the most prompt in the world at making payments, sent to say it was ready. I have twice spoken to them about taking it away; evidently they are not prepared with the needful. Can I sell it to defray expenses, or what is my remedy?—J. B.

[52896.]—**Zinc Labels.**—What is the best fluid to use to write the names of fruit, rose trees, &c., on zinc labels that they may be legible and not wash off? I find the ordinary acids from acting too powerfully on the metal cause the letters and words to run one into the other.—A. Lloyd.

[52897.]—**Moving Lantern Slides.**—Wanted, instructions how to make such slides as Snowstorms, Choreutoscopes, Kaleidotropes, and others. I have the necessary tools, lathe, and materials.—A. E. H.

[52898.]—**Improved Carrier for Lantern Slides.**—I read with considerable interest the paper on p. 423 (Jany. 18th) of your journal on the Improved Carrier for Lantern Slides. I have a difficulty in understanding how the slide is expelled from the carrier, and shall be glad to have further information. It is a question whether it is desirable to so quickly change a lantern view. I shall be interested to learn what your readers think on the matter.—Arcanum.

[52899.]—**To S. R. Bottone.**—Can I drive a dynamo made according to your instructions so that I can light four Swan's 5-c.p. lamps without damage to the dynamo, and at what number of revolutions per minute would it have to be driven (say) for a continuous light of six hours?—Electric.

[52900.]—**Water, Steam, or Sand Bath.**—Would some reader kindly furnish me with a simple design for a water, steam, or sand bath which might be used with safety for the evaporation of alcohol out of turpentine? All that I want is a small one which will give a steady heat of about 180° Fah. to a pint of material. I would like the vessel containing this to be at least two yards from a Bunsen burner which I have fitted up in a garden.—A. Howland.

[52901.]—**Working Models by Electricity.**—I am making a working model to work for a penny, and the common eight-day clock-spring is rather too weak for the movements. Could any of your readers inform me if it could be worked by electricity, what kind of apparatus to get for it, and what space it would take up?—D. T. W.

[52902.]—**Photography.**—Is there any way of developing a latent image on the ordinary sensitised albumenised paper, as can be done on a gelatino-chloride dry plate?—J. B.

[52903.]—**Atmospheric Pressure.**—As the pressure of the atmosphere tends to raise bodies, would it be correct to say that a person will feel more oppressed on a high mountain than at the sea-level, or do other laws counteract this?—J. B.

[52904.]—**Gas Generator.**—Would some kind reader kindly give description of gas generator suitable for one of Fletcher's 2lb. injector gas-furnaces for casting brass, as I believe there are several beside myself who would prefer to make their own? Am a fair sheet-metal worker. Any information would be acceptable to—Generator.

[52905.]—**Gas Threads.**—Would any reader oblige me by letting me know the number of wheels wanted for cutting gas threads in the lathe from 2in. down to ¼in. pipe? The lathe I have to cut them in is one of Campbell and Hunt's screw-cutting lathe. The travelling screw is ½in. pitch, and have wheels from 120, 110, 100, [illegible] 90, 85, 80, and so on down to 20.—Young Beginner.

[52906.]—**Small Dynamo.**—To Mr. S. R. Bottone.—I wish to construct a small machine on Heinrich's principle capable of maintaining 14 lamps 10-candle power Swans. Will you kindly give me the size of machine, the number of wire for field-magnets, the size of ring, and number of wire for same? I am at a loss to understand how this annular core is constructed! Is it an iron casting, and would it not be better to wind the armature with a gap in the iron core so as to slip the coils on, then fill up with a piece of iron to complete the iron continuity?—A. Wilkinson.

[52907.]—**Circular Saw on Lathe.**—I have found this a nuisance, as I cannot saw a piece of wood in two 18in. long, because the head of the lathe is in the way. How can I adjust a pair of centres so that the edge of the saw will come quite 1in. above, and to be worked by the lathe-head? Others must have found the same difficulty, and stop short the same as—Jobbing John.

[52908.]—**Stained and Coloured Glass.**—[illegible] this is so very fashionable, would not a few lessons in "ours" be acceptable to ornament our back windows to hide the unsightly view of bricks? Should be glad to know the probable cost of the lead and the different glasses before proceeding. And, can a pattern painted in colours be burnt in by one of Fletcher's gas apparatus at home?—Jobbing John.

[52909.]—**Barlow's Wheel.**—Will any of "ours" kindly explain the theory of the action of this piece of electrical apparatus? I should like to know how both forms work—viz., the copper disc wheel and also the stellar wheel. I have the instrument and can make it revolve, but cannot find the action explained in any text-book.—E. D.

[52910.]—**Photographing Gas Flame.**—I should be glad if some of your photographic correspondents would kindly say what is the very simplest plan of getting a photographic picture of a gas-flame? A negative on paper would suit my purpose, as I only require one at a time. I may say that I have experimented with [illegible] paper, but the trouble is rather too great. Is there a simpler plan?—J. Thorp.

[52911.]—**Electric Motor.**—To Mr. S. Bottone.—I am constructing an electric motor similar to the one you are illustrating in the present vol. of "E.M." Size of limb on field-magnets 4in. wide and 5in. high from pole faces; pole faces are 6in. long and made heavy; the armature (Siemens) is 6in. long, and the web ½in. thick and 3in. diameter. What I want to know is this—Will these sizes do? I have got 10lb. of No. 14 c.-c. wire, B.W.G. Will this be enough for the field-magnets? If so, how much wire, and what size, shall I want for the armature? Should the resistance in armature be the same as field-magnets? Should I insulate each layer of wire on field-magnets with calico varnished with shellac? Or, will paraffin wax be sufficient?—Alfonso.

[52912.]—**The "Edco" Battery.**—To "C. R. H."—I have 26 carbon plates 5in. by 2in. by ⅜ thick. Will these do for a battery after the principle of the "Edco" battery or the automatic battery as advertised in "E.M."? If so, will you kindly give me particulars for the construction of one?—Alfonso.

[52913.]—**Armature.**—To Mr. Bottone.—I have an armature made up ready for winding in malleable iron, and I have been told it is not any use because it is too hard—it ought to be special iron. What is special iron, and where can it be obtained? If Mr. S. Bottone will inform me, no doubt he will oblige others besides—Volt.

[52914.]—**Dynamo.**—To Mr. Bottone.—A dynamo at 1,100 revolutions per minute gives off 5 volts and 40 ampères. What would the increase of current be if speed was raised to 1,600? Armature 6in. dia., 5in. wide, and wound with 9lb. of 14 wire, 40lb. of 10 wire, on magnets. Can you give me some instructions how to make an instrument to measure the ampère current of a dynamo?—Volt.

[52915.]—**Violoncello.**—Is this instrument made in the same way as the violin—i.e., with inside or outside mould? How are the ribs bent, and what is the thickness of them? What special tools are required? Does beech wood or maple turn out the best job as regards tone, and can the front be made in one piece if a very equal piece of pine can be procured? Would any reader kindly inform as to the above, or refer me to the back numbers of the "E.M.," where the subject is fully treated? I can find little or nothing on the subject in the last three vols. beyond certain measurements, &c.—A. H. S.

[52916.]—**American Organ.**—Would Mr. Fryer or "Organon" kindly give me size of bellows and reservoir required for an organ I propose to build containing two manuals, the upper one consisting of 3 rows, and the lower one consisting of 3½ rows; also 2 octaves of pedal notes with octave coupler on lower manual? I may add the recess I propose to place it in is 4ft. by 2ft. 6in. Any other information respecting the strength of the springs and the distance the bellows will require to open will greatly oblige—American Organ.

[52917.]—**Gas Flames.**—To Mr. Thomas Fletcher.—Will you kindly answer me the following question?—Many years ago I understood from a gas authority that if a gas flame was turned low when not required the consumption of gas was at least as much as when fully burning. His words to me were—"It consumes more gas without giving a better light." Is this so? We must perhaps take into consideration the improvement in gas burners since thirty years ago.—Geo. H. Lancaster.

[52918.]—**Transmitter.**—To Mr. Strangways.—Having constructed transmitter according to directions given in recent number of "E.M.," should be glad to know the object in making the piece of wood attached to one cone of carbon longer than other; and, also, is lead wire used simply for a weight? Will shot flattened out do as well? Not having seen description of your clear-speaking telephone in "E.M.," should be glad to learn the number; and can one be used in private house without infringing any rights or patent?—Electron.

[52919.]—**Electrotyping.**—Will some reader kindly explain the following? I have a dynamo that gives 42 ampères and 3 volts at 1,100 revs. per min., and when I put my work into circuit the machine will work for a few minutes and then the current dies away. Will some one tell me where I am wrong? Also how many square feet a machine giving out the above power will deposit on, and at what rate? I want to deposit the copper in small pieces about 1⅞in. long, 5-16in. thick, and in various widths from ¼ to 2in. Cathodes are of metal. Is the solution the same for the machine as for the battery? If not, what is the difference? It takes about five weeks to get the above thickness with Smee's battery working constantly. How long will it take with the dynamo? Can Mr. Bottone give me any information?—Volt.

[52920.]—**Legal.**—A. died on the 1st June, 1881, leaving to her niece, B., all her personal estate, consisting of gas, railway, bank, and other shares. Owing to technical legal difficulties the estate of A. had to be thrown into Chancery. On the 17th December, 1881, B. died also, making no will, and the Chancery suit undecided. We expect the Chancery suit to be tried out soon, and the question is, To whom does the money belong? The husband of B. claims the money, and says what belonged to his wife belongs to him. The children of B. think they are entitled to the money, and they wish to prevent their father having the money, because they know that he will leave it all to their step-mother. Will some of your legal correspondents kindly enlighten us in this matter? Does the estate of B., under the circumstances named, belong to the husband of B., or to the children of B.? The estate of A. does not include any real property.—S. Barnett.

[52921.]—**The Action of the Pump.**—To Mr. P. J. Davies.—Can it in practice make any difference in the effective working of a pump that the greatest rise in suction pipe should occur at a point about two-thirds the distance between the well and pump—the pipe having a fall both ways, highest point being 22ft. above well and 6ft. above pump? Plumber (who has spent two days trying without effect to make it draw) says the cause of his failure is this rise and fall in the suction-pipe; and that in a similar case he once had before the difficulty was got over by raising the pump till a continuous fall to the well was obtained, and then that pump drew the water without any trouble. It seems to me that this theory cannot have a foot to stand on.—F. C.

[52922.]—**Legal.**—An association, say, with a working committee of 12, runs into debt to the amount of £15. There appears to be no means of collecting this sum. The committee then resolve to obtain from each member a guarantee for the sum of 25s. each. Eight of these pay their amount; but the other four do not. Can creditors call upon the whole 12 for arrears, or are the remaining four only liable? I may add that in exchange for the above guarantee each member obtains from the association a guarantee that they will not be held liable for anything more than the amount (25s.) guaranteed by them. It is the legality of the latter that I wish to test.—Schiox.

[52923.]—**Micro.-Photography.**—How can I take small pictures, say the size of a pin's head, to be afterwards magnified under a microscope? How can they be developed? Any information will be welcome; but I should like the whole process.—P. C. W.

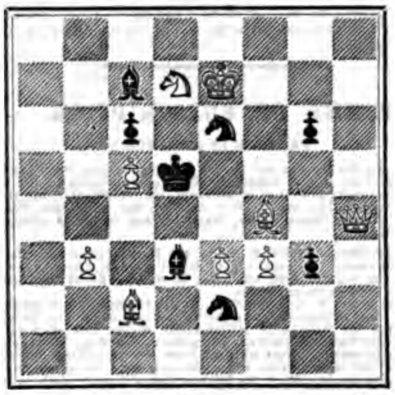
[52924.]—**Removing Tricycle Wheels.**—Can any one possessing a Bayliss and Thomas Tandem tricycle say if nut on outside end of axle (under the gun-metal cap) is intended to be fixed? Want to take wheel off, but cannot move nut with ordinary wrench.—Fixed.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXXII.—By J. B., of Boxford

Black.



White. [9+8

White to play and mate in three moves.

Solution to 870.

White.	*Black.*
1. Q-K Kt 2	1. Anything
2. Anything	2. Q, B or Kt mates

(7 variations.)

NOTICES TO CORRESPONDENTS.

Correct Solutions to 871 by Arcanum (a pretty and difficult problem) and R. A. Bennett (very neat); to 870 by D. Millar, J. G. E. (Sittingbourne), A. Schmucke, Rev. W. Anderson, R. A. Bennett, W. H. Evans, W. J. Francis, and Demetrius; to 869 (second solution) by W. J. Francis, R. A. Bennett, J. G. E.

R. A. B.—It appears to be a true bill.

W. J. Francis.—Your solution of first tourney problem is correct; but it has been sent too late to score.

W. Anderson.—The two works are quite distinct. "Chess Problems," with supplement, are original. "English Chess Problems" constitute a selection of the best problems by English composers. The price of the latter is 9s.

J. Grey.—The games given belong to a Tourney now nearly concluded; but we are about to start a new one, and shall be happy to enter your name. The fee is 5s., to make up a prize fund. Five members have already joined; but a dozen are wanted.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

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*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

BACK NUMBERS.

We receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 734, 741.
Bellows camera: Nos. 894, 897.
Bookbinding: Nos. 613, 770.
Coils, induction: Nos. 832, 885
Coils, medical: Nos. 844, 898.
Copying processes: Nos. 750, 753, 761, 762.
Electric machines: Nos. 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Electro-plating: No. 833.
Lacquers: Nos. 622, 866.
Magneto-electric machine: Nos. 783, 826.
Silver-plating: Nos. 830, 868, 870, 874.
Telephones: Nos. 692, 695, 747, 781, 809, 828, 846, 853, 865, 894.
Varnishes: 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 30, and unacknowledged elsewhere:—

W. T. Underwood.—W. Robbins.—H. C.—Sydney.—W. B.—Engineman.—Eccleston.—Ferro.—Fluid.—Markham.—Granville H. Sharpe.—Ariba.—J. W.—T. Tindall.—A Jerry Shed.—Cynoru.—G. B.—W. Jones.—M. D.—S. Freestone.—D. and W.—Naphtha.—G. Russell Pridham.—A. W. Lambert.—Mechanic.—P. Ward.—John Hale.—S. G. Hart.—Leigh S. Powell.—Locomotive.—J. E. Gore.—G. J. H.—Ninip.—Apprentice.—L. C.—G. Gray.—C. B.—J. I. S.—Newton.—Binder.—Amateur.—J. H.—W. Routledge.—G.—L. B.—W. R. Bousfield.—T. G. Elger.—C. E. Stretton.—Blowpipe.—J. F. Wilkinson.—J. M. Offord.—E. J. Lawrence.—Model.—Cosmos.

R. Holt. (Merely because the hair is expensive. We think it quite possible that some amateurs could make them as well as professionals, if not better.)—W. F. Holmes. (Two: London and York. The Mayor of Dublin also takes the title. 2. It is partly due to refraction, and partly to the fact that comparison with other objects enables a better estimate of the size to be made. 3. Air currents rushing into areas of low pressure from parts where the barometer stands high.)—P. C. W. (You explain now. We do not think the details have ever been published. There was a descriptive article in Vol. XIV., but the number is out of print. Will insert a query. Two numbers containing tolerably complete instructions in soldering have been forwarded. As to the glue, any good glue; but binders for cheap work use the lowest priced.)—Young Wife. (A dozen queries at once is more than we can manage, especially when most of them have been answered many times.)—Would-be Traveller. (One of Cook's "Tourist Guides" would answer the query fully. Write for particulars to Ludgate Circus.)—Small Power. (For explanation of principle of gas-engines, see p. 101, Vol. XXXIII., and the indices for many references to illustrations.)—Vikil Charon. (What about the temperature? The deepest mine is a mere indentation compared with the diameter of the earth, and it is uncomfortably warm at that depth.)—H. B. B. (Both queries are advertisements. The glasses can be obtained at any large musical instrument warehouse. As to the book, we know of nothing of the kind.)—Lloyd Waymouth. (No one can say without examining it. Read the subject in the articles, and then endeavour to discover the reason.)—Shopkeeper. (See pp. 356, 380, Vol. XXXII., and the indices generally. The question has often cropped up. It is a simple matter of efficient ventilation.)—E. Jones. (The spirit level was first described by Thevénot in 1666, and he is considered the inventor.)—J. M. Wood. (It would serve no good purpose to engrave the sketch. We gave drawings on pp. 112, 247, and 260, and to answer a question why anything made like them does not work would necessitate personal inspection.)—G. P. H. (Apparently, it is the remains of a Daniell. Directions for making up have been frequently given. See p. 537, Vol. XXXVI., or almost any textbook.)—J. K. O'C. (It is much better to buy it than to attempt to make it in small quantities; but you will find recipes for various kinds on p. 311, No. 325.)—L. B. B. (There is the "Micrographic Dictionary"; but that, perhaps, is beyond your requirements. We do not know of any cheap work giving all the more common objects; but try the catalogue of Van Voorst, Paternoster-row.)—Clachan. (The delay is often considerable in the U.S. office before the patent is issued.)—Pirate. [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 8, 1884.

THE STANLEY CLUB SHOW.

THE seventh annual exhibition of bicycles and tricycles held under the patronage of the Stanley Bicycle Club was opened at the Floral Hall, Covent-garden, last Monday. The change of location is advantageous in some respects; but if makers are to derive any benefit from these annual shows, it is at least essential that the public should be able to examine the machines, and compare their relative merits. The present exhibition, however, is so crammed that although there is just walking space on the floor area, it is simply impossible to get round the galleries with any comfort, for if one or two visitors stop to look at a machine there is at once a "block." It is certainly the interest of the manufacturers to insure ample space in which the public can examine their machines; and on the present occasion one well-known firm refused to accept the stand allotted them, and took their machines away to a temporary warehouse.

Visitors will of necessity have noticed that the tricycle is the machine that nowadays comes to the fore. Amongst bicycles there is, so far as the machines themselves are concerned, little improvement and no novelty to record, if we except the doubtful advantage of a device to enable any one to ride a taller wheel than his legs are suited for with the ordinary patterns. This is an arrangement in which the backbone stops at the rear end of the saddle, and is connected with the head by extension pieces which bend down below the rim of the wheel on each side. The saddle is thus brought nearer to the treadles, and it is claimed that the rider can have a wheel 4in. larger than is possible with the ordinary arrangements. The device is patented; but it will scarcely commend itself to riders. The novelty in the bicycle line is the "Tandem" bicycle of Rucker and Co., which is a novelty as far as exhibitions are concerned, though it is known to experts as a machine that does when well ridden travel at a tremendous pace. It is merely two large wheels joined together by a bar connecting their heads. Each rider, in fact, drives the big wheel of a bicycle, and the small wheels are missing; but as both are connected together by a bar, it is obvious that both riders must drive at exactly the same speed, or there will be slip. Apparently the machine has to be held for the foremost rider to mount, and then when he has got the affair into motion the rearmost gets on by the aid of a step. As there are only two wheels, and each one is driven, it is obvious that, provided both are driven with an equal amount of power, very high speed can be attained; but it is also obvious that steering is not easy, and that expert riders are necessary to prevent an awkward tumble. The novelty of the show is the "Oarsman" tricycle, invented by the Rev, J. M. Taylor, of Seer Green Vicarage—one of our old correspondents. In this machine the action is as nearly as possible identical with that of rowing. The feet are placed firmly against two footplates, and the toes control the steering wheel, which is held firmly in position; in fact the steering is nearly perfect. The seat slides on runners placed at an incline, and the hands grasp a horizontal adjustable bar which is connected to cords on either side. These cords pass over pulleys, two of which, by means of a clutch action, give motion to the driving wheels. The body comes down with the seat by the action of gravity until the knees are bent and the horizontal bar is in close proximity to the feet. The muscles of the legs, back, shoulders, and arms are then brought into play, and the body being straightened, the seat runs up the inclined guides, and a very powerful stroke is given, so powerful that a heavy man like Mr. Taylor can make eight miles an hour on fairly good roads with fifteen strokes per minute. There is practically no exertion in getting forward to the work, so the power exerted is all utilised in driving, save that required to overcome friction of the parts. As a machine for exercise, the "Oarsman" undoubtedly takes the first place; but we suspect that Fashion will prevent its frequent appearance on public roads. Another novelty is the Otto tricycle, with front steering wheel, and centre gear on a swinging frame. We mentioned this machine on p. 312, and now that we have seen it as actually built, can safely say that it is one of the attractions of the exhibition. The arrangement of the steering gear, which practically compels the rider to lean over to the proper side, is a useful feature, and the wheels, with spokes secured to three rims on the hub, give an appearance of immense strength, which has been amply borne out by such tests as have been made. To take the exhibition as a whole, there is not much improvement to record, for although tricycles can be seen in all sorts of shapes, the old and well-known patterns are still exhibited, and still have in some cases the spoon brake, which has been the primary cause of not a few unpleasant accidents. The spoon brake is no doubt very powerful and efficient when applied with equal force to both wheels; but if through some defect one wheel is not held and the other is, the result is obvious There is a tendency to decrease the size of wheels, to prefer enamel to nickel plating, to use tangent spokes, and an evident desire to provide some simple form of gear by which the speed can be altered whilst running. To describe all those devices is impossible in our space; but as a matter of fact most of them are well known—as well known as the extraordinary statements which some makers still persist in putting in their lists. For instance, it is not uncommon to find it stated that "the centre of gravity of this machine is very low," when it is obvious that it is very high. Amongst the machines which especially attracted our attention was the Duplex Tandem Excelsior of Bayliss, Thomas, and Co., Coventry, which is received with much favour by those who require a "sociable." The firm also has a good exhibit of their well-known makes. The Centaur Cycle Co., of Coventry, also show several convertible and combination tricycles which should be seen by those looking out for sociables. Ellis and Co., of Fleet-street, exhibit several Faciles, including that on which Mr. Adams did his famous ride of 242½ miles in 24 hours. Devey and Co., of Wolverhampton are noticeable for an exhibit of serviceable-looking machines at low prices—one being a 52in. bicycle for less than £5. Starley and Sutton exhibit amongst their machines the Rover, a rear steerer, in which the rider sits between the axle and the hind wheel, and directly over the treadles. Some of the objections to rear steerers are overcome in this machine. Mr. Bown, of Birmingham, is as usual present with his well-known bearings, fittings, and stampings, and also a patent speed gear for tricycles. Burdess and Co., of Coventry, exhibit several of their favourite Sterling tricycles, and the South London Machinists' Company, of Tower Chambers, Moorgate-street, show most of their well-known patterns. Their Flying Scud Convertible Sociable is worth the attention of those on the lookout for machines of the class, while the Paragon, a Humber-pattern tricycle, will suit those who want high speed with a wear-and-tear machine. The Antelope is a machine in which the rider sits behind the axle; but it is open-fronted, and can be readily mounted from front or back. The tube covering the axle serves as footrest when running down hill, and the whole weight can be thrown on the treadles when necessary. The Gnat tricycle, shown by the Metropolitan Machinist Company, has 30in. wheels, and is sure to attract considerable attention. Kelsey and Kelsey, of Birmingham, exhibit their ventilated handles, which we illustrated on p. 8 of the last volume. We also noted one or two machines having handles sheathed with cork. Two or three makers show machines with aluminium fittings; but we suspect that metal is still too costly to meet with much demand in the construction of cycles. The Merlin and the Englefield are representatives of those machines which work by a clutch action, in which the stroke given by the leg can be of any desired shortness. Little improvement seems to have been made in folders or telescope tricycles; but the Sutton reducible, to be seen at Stall 75, is, perhaps, the best arrangement for removing one of the wheels in order to get a tricycle through a doorway. In this machine the axle is cut so as to form a sort of scarph joint, which is secured by a couple of nuts with left and right-hand threads respectively. Several machines for carrying luggage are shown—in one case as much as 150lb., which is carried in a basket in front of a rear-steering machine, the weight being supposed to be balanced by that of the rider. There is a demand for machines of this kind, and we expect to see something better produced before long. Altogether, we may fairly conclude that the art of cycle building has reached a high degree of perfection in 1884, and the "fittest" amongst the many patterns are those that will survive.

THE ACHROMATIC OBJECT GLASS.—

XXX.

By W. BRADBURY.

Brewster's Remarks.

IN Brewster's edition of Ferguson's Lectures, published in 1806, there is an interesting article on the object glass; which, though it was written when optical science was in its very infancy, contains information which will still attract attention. A number of tables of different forms are given: I have greatly condensed these, because the ten or twelve horizontal lines of numbers containing the radii for a progressive increase of focus, are but multiples of a standard ratio. This I have taken to be the radii required to produce a focal length = 1·000, as in previous examples; therefore the values of the curves are decimal parts of this quantity.

After explaining how achromatism is produced by media of different dispersive powers, the writer thus proceeds:—

"Having thus discovered that light could be refracted without colour, the next object of philosophers was to ascertain the curvature which must be given to lenses in order to produce this effect, and likewise to correct the spherical aberration. This subject has been treated with the greatest ability by several foreign mathematicians; but particularly by Euler, d'Alembert, Clairaut, Boscovich, and Klugel. The writings of these philosophers furnish us with the most complete and accurate information upon this point; and art has in this case received from science all the assistance which she possibly can bestow. It shall be our object at present to reduce the results of their investigations, either into tables, or into such a form as may be easily comprehended by the practical optician, and thus to furnish the artist with a popular view of this interesting subject. For this purpose, the celebrated Euler has given, in his Dioptrica, two formulæ, from which we have calculated the two following tables, containing the radii of curvature for the lenses of a triple object-glass. The first column contains the focal distance of the lenses when combined; and the six following columns contain the radii of their curvature in decimal parts of the focal length."

In the seven succeeding tables, the crown index is 1·526, the flint index 1·604, and the ratio of the differences of the extreme indices in crown and flint glass, 0·6054.

TABLE I.—Radii of a Triplet according to Euler's first formula.

Focal length.	Convex of Crown glass.		Concave of Flint glass.		Convex of Crown glass.		Hemi-aperture.
1·000	·5008	2·666	·5166	·4843	·5218	·4757	·119

TABLE II.—Radii of a Triplet according to Euler's second formula.

1·000	·2836	2·072	2·146	·2955	·5938	2·500	·0706

"The only person in our country who has written upon the theory of achromatic object glasses is the late learned Dr. Robison, of Edinburgh, who, following the steps of Clairaut and Boscovich, has given an interesting dissertation upon this subject. From the formulæ contained in that dissertation, the following table is computed":—

TABLE III.—Radii of a Triple Object-Glass.

Focal length.	Convex lens Crown glass.		Concave lens Flint glass.		Convex lens Crown glass.	
1·000	·757	·3055	·3055	1·059	1·059	·1067

A telescope 30 inches in focal length, constructed according to this table, bore an aperture of 3·2 inches.

"The reader will observe that only three pairs of grinding tools are necessary for constructing a telescope according to the preceding table; but the work may be performed by only two grinding tools, if we employ the radii of curvature which are contained in the following table, computed from the formula of Boscovich:—

TABLE IV.

Focal length.	Radii of the four surfaces of the two lenses of crown glass.	Radii of the two surfaces of the concave flint lens.
1·000	·640	·528

"The radii of curvature employed by the London opticians are pretty nearly represented in the following table, which is calculated from Dr. Robison's measurements.

TABLE V.

Focal length.	Convex lens of Crown glass.		Radius of both surfaces of Flint lens.	Convex lens of Crown glass.	
1·000	·628	·749	·579	·628	·749

"Two of Dollond's best achromatic telescopes being examined, were found to have their lenses of the following curvatures, reckoning from the surface next the object:—

$$\text{Crown lens}\begin{cases}28\\40\end{cases}\text{Flint lens}\begin{cases}20\cdot9\\28\cdot\end{cases}\text{Crown lens}\begin{cases}28\cdot4\\28\cdot4\end{cases}$$

Compound focal length 46in.

$$\text{Crown lens}\begin{cases}28\\35\cdot5\end{cases}\text{Flint lens}\begin{cases}21\cdot\ 1\\25\cdot75\end{cases}\text{Crown lens}\begin{cases}28\\28\end{cases}$$

Compound focal length, 46·3in.

Both these telescopes magnified from 100 to 200 times, according to the powers applied. The Duc de Chaulnes having in his possession one of Dollond's best telescopes, whose focal length was 3ft. 5in. 4·25 lines, made a variety of accurate experiments to determine the curvature, thickness, and distance of its lenses, and found them to be of the following dimensions:—Radius of first surface next the object 25in. 11·5 lines; radius of second surface, 32in., 8 lines; radius of third surface, 17in., 10 lines; radius of fourth surface, 24¼in.; radius of fifth surface, 24¼in.; radius of sixth surface, 26in., 10·6 lines. Thickness of first lens at its axis, 2·11 lines; thickness of second, 1·59 lines; thickness of third, 2·18 lines; thickness of the whole lens 5·91 lines."

The next extract is very interesting, from the fact that the objective closely resembles one of those described by "Prismatique" It proves that, even in those early times of optical art, this form had been found to give a very satisfactory glass.

"A very excellent telescope, with a double achromatic object-glass, was constructed by M. Antheaulme in 1763, from the formulæ of Clairaut. The lens of flint glass was placed next the object, and was a meniscus with its convex side outwards. The radius of its concavity was 17·25in. and the radius of its convex side was 90·66in. The interior surface of the lens of crown-glass had a radius of 16in., while its exterior surface, or that next the eye, was 90in. These lenses were separated by a piece of card, and formed a compound object-glass, with a focal length of 84, and an aperture of 3in. and 4 lines. Its eyepiece consisted of two lenses; that next the object was a double convex with 18 lines of focal length and 9 lines of aperture. Its first surface, or that next the object-glass, had a radius of 11·5 lines, and its second surface a radius of 7in. 2 lines. The second eye-glass, which was a meniscus, had 5 lines of focus and 2 lines of aperture. The radius of its convex surface was 2·25 lines, and that of its concave surfaco, which was next the eye, was 8 lines. The distance between the two eye-glasses was 9 lines.

"The following table, calculated from the formulæ of Boscovich, contains the radii of curvature for the lenses of a double achromatic object-glass:—

TABLE VI.

Focal length.	Convex lens of Crown glass.		Concave lens of Flint glass.	
1·000	·3232	·318	·318	1·5625

In the following table, calculated from Dr. Robison's measurements, the reader will find the radii of curvature which are employed by the London artists:—

TABLE VII.

Focal length.	Convex lens of Crown glass.		Concave lens of Flint glass.	
1·000	·2938	·3526	·3443	1·1474

"Although it has been the practice in this country to construct only double and triple achromatic object-glasses, yet they may be composed even of four or five glasses, the convex ones of crown glass, and the concave ones of flint glass, being placed in an alternate order. By augmenting the number of media, indeed, a quantity of light must be lost, and the labour of the artist greatly increased; but M. Jeaurat informs us that he constructed a compound o.g. 5in. and 10 lines in focal length, which bore an aperture of 1¼in., while the best achromatic telescopes of 6in. focus constructed in England had an aperture of only 1¼in. To such, therefore, as wish to construct object-glasses of this description, the following table, containing their radii of curvature, may probably be acceptable.

TABLE VIII.—Quadruple O.G.'s.

Mean refraction of crown to that of flint, as 1,000 to 1,045 dispersive power—as 200 to 353.

Focal length.	Radius of six interior surfaces.	Radius of two exterior surfaces.	Aperture. of o.g.
4	3·08	3·56	1·25
6	4·50	5·33	1·50
8	5·92	7·18	1·83
10	7·33	8·33	2·17
12	8·83	10·58	2·25
24	17·33	21·17	2·58
36	25·83	31·67	2·92
48	28·42	42·25	2·25
60	42·92	52·75	3·58
72	51·50	63·33	3·92
84	60·00	73·83	4·17
96	68·58	84·42	4·50
108	77·08	95·00	4·83
120	85·58	105·50	5·17

Though it is demonstrable that a telescope, constructed according to the preceding tables, and formed of glass whose refractive and dispersive power is similar to that which was employed in the formula upon which these tables are founded, will form an image perfectly distinct and colourless: yet it is so difficult to procure flint glass of the same refractive and dispersive power, that it is almost impossible for a private individual to succeed, even after several trials. The London opticians have always at hand a number of lenses of various curvatures and different powers of refraction and dispersion, and by selecting such as answer best on trial, they are enabled to construct an object-glass in which the spherical and chromatic aberrations are almost wholly corrected. Those, therefore, who are not furnished with a sufficient number of lenses must necessarily meet with frequent disappointments in their attempts to construct achromatic telescopes; and the only way of preventing these disappointments and rendering success more certain, is to have a variety of tables, which being founded on different conditions give different curvatures to the lenses. If the artist should be unsuccessful, either from the nature of the refracting media which he employs, or from giving the lenses a greater or lesser curvature than the table requires, he may with very little trouble sometimes, with altering the radius of a single surface, adapt the lenses to the conditions of some other table, and in all probability obtain a more favourable result. With the view of facilitating these attempts, we have computed the eight preceding tables, and for the same purpose we shall subjoin the following different forms of achromatic object-glasses from Boscovitch and Klugel.

Forms for Triplets. Crown index 1·[illegible]. Flint index 1·604. Ratio of differences of extreme indices ·6054, for second and third forms. Focal length 1·000 in all cases.

1st Crown lens, equi-convex, radius..................	·6412	: focus [illegible]
2nd Flint lens, double concave, radii	·5227 ·5367	: focus [illegible]
3rd Crown lens, equi-convex, radius..................	·6412	: focus [illegible]

1st Crown lens, equi-convex, radius..................	·530	: focus [illegible]
2nd Flint lens, equi-concave, radius	·530	: focus [illegible]
3rd Crown lens, double-convex, radii	1·215 ·3046	: focus [illegible]

1st Crown lens, equi-convex, radius	·616
2nd Flint lens, double concave, radii	·5556 ·3790
3rd Crown lens, equi-convex, radius	·616

In the following forms, crown index = 1·5[illegible] flint index, 1·575; ratio of differences of extreme indices, ·6486.

1st Crown lens, equi-convex, radius	·4748
2nd Flint lens, equi-concave, radius	·4748
3rd Crown lens, double convex, radii	·3514 ·4383

1st Crown lens, double convex, radii	·3721 1·5744
2nd Flint lens, equi-concave, radius	·4748
3rd Crown lens, equi-convex, radius	·4748

1st Crown lens, equi-convex, radius	·7963
2nd Flint lens, equi-concave, radius	·4748
3rd Crown lens, equi-convex, radius	·5023

1st and 3rd lenses of equal foci placed inversely—

Crown lens, radii	·7306 ·5325
Flint lens, equi-concave, radius	·4748
Crown lens, radii	·5325 ·7306

1st and 3rd lenses of equal foci placed directly—

Crown lens, radii	·7048 ·5471
Flint lens, radius	·4748
Crown lens, radii	·7048 ·5471

Forms for double object-glasses—

Crown lens, equi-convex, radius	·3306	focus ·3466
Flint lens, double concave radii	·3301 1·533	.. ·4384

Crown lens, radii......	·2168 ·7092	focus .... ·3123
Thickness	·0079	
Flint lens, radii	·4606 ·5740	focus .... ·4397
Thickness	·0031	
Separation of lens	·0031	
Aperture	·0937	

These two forms are calculated from Klugel's formulæ.

By glancing over this list, and comparing the various forms, the reader may gain some knowledge of the wide difference in arrangement advocated by eminent theorists. Euler employed a lens having a minimum of spheric error: Robison and Boscovich endeavoured to get as many equi-curved surfaces as possible, thus

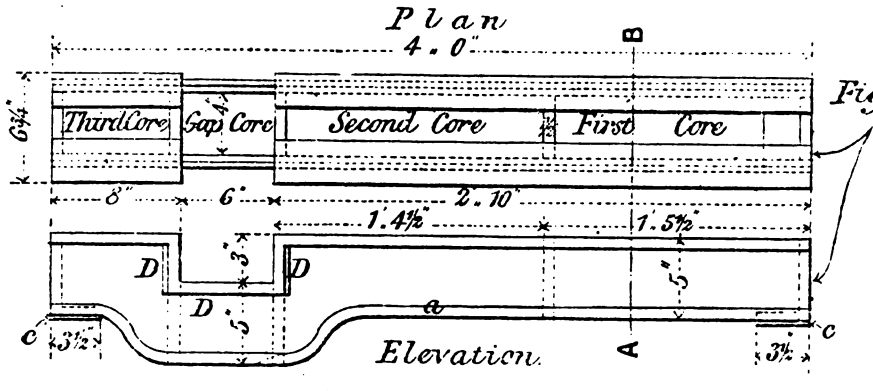
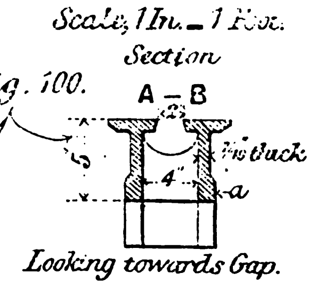


Fig. 100.



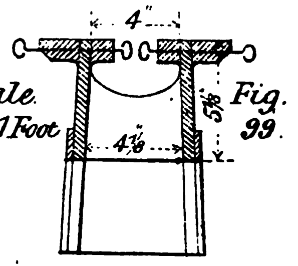


Fig. 99.

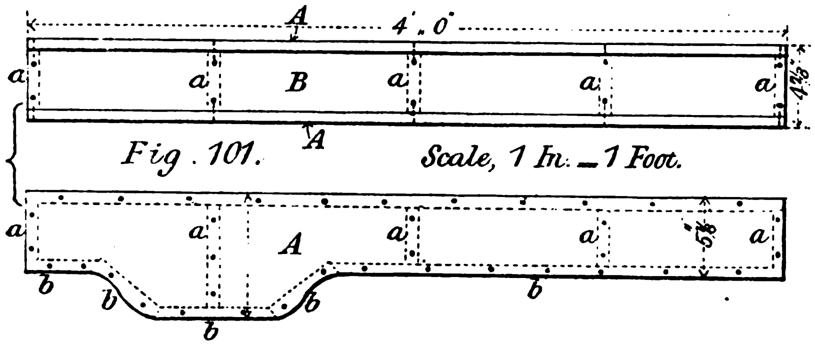


Fig. 101.

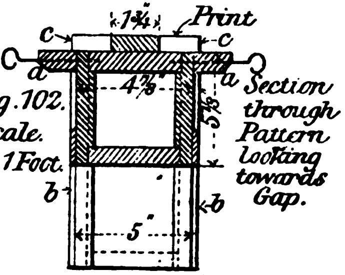


Fig. 102.

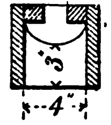


Fig. 108.

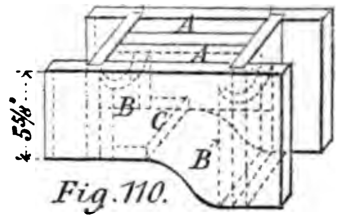


Fig. 110.

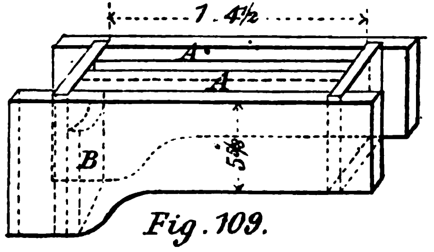


Fig. 109.

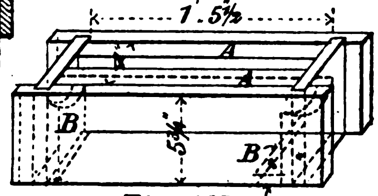


Fig. 107.

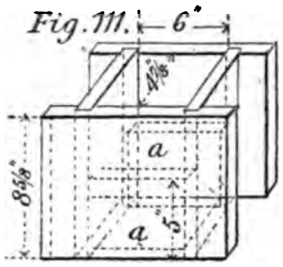


Fig. 111.

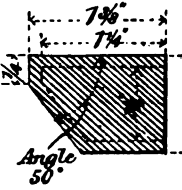


Fig. 104.

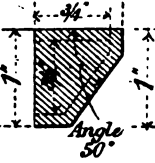


Fig. 105.

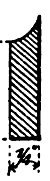


Fig. 106.

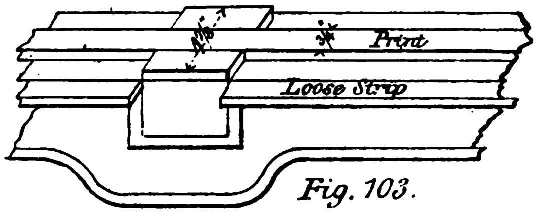


Fig. 103.

avoiding a multiplicity of tools; Klugel did the same with the double o.g., by making the first three curves alike; Clairaut places the flint in advance of the crown, and in his combination also there appears to have been an attempt to make the four radii in two pairs—that is, both inner sides alike and opposite, and both outer sides alike convex.

(*To be continued.*)

HOW TO MAKE A CHEAP LATHE.—VIII.

Supplementary.

THE task I undertook to perform is now complete, and I therefore proceed to redeem the promise made in answer to letter 21912—to describe in a supplementary chapter the mode of construction of a common gap bed, and the modifications such a bed would entail in our first design.

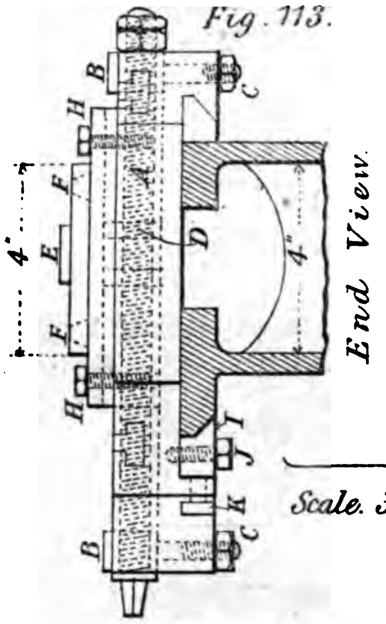
There are two ways of making beds: one is to construct the pattern like the casting, leaving certain parts loose, and giving due taper, both to external and internal parts. The other is to box up a pattern, and to core out the internal portions. Of these two methods I am going to describe the latter; because, firstly, I have found details concerning taper and dowelled pieces very puzzling to people (even engineers themselves) not actually trained as pattern makers or moulders; but chiefly because with a cored-out pattern there is less chance of an untrue casting being produced, such a pattern being less liable to become rammed winding, or otherwise out of truth in the sand. If I were going to make a small bed such as this is, for myself, knowing the moulder who would mould it, and that I could check it with straightedge and strips in the sand, I would not bother with cores; but if cast in a strange foundry, perhaps by men unaccustomed to this class of work, I would not run the risk of getting a crooked bed by constructing a pattern of so slight proportions. To such as wish, however, to mould in greensand simply, the view of Fig. 99 is self-explanatory. A pattern made thus (one only of two or three methods) will be made correctly for moulding.

Fig. 100 shows a fairly proportioned bed for our headstocks. It might perhaps be lengthened six inches with advantage, dependent upon the class of work for which it is to be adopted. Also iron standards should be substituted for the wooden ones of our cheap lathe. The saddle of the slide rest will also be modified in form. Let us consider each in turn.

The bed, then, first in order. "Box up" the main body of the pattern, Fig. 101. Procure some inch board, out of which cut two sides, (Fig. 101, A A A) slightly larger than the outline of the bed. Rebate them ⅛in. deep to the width of an inch all round, and also across where the ribs or stays *a a a a a* are to come. Then prepare one piece for the top (B) 4ft. 0⅛in. long by about 3⅜in. wide. We say "about," because the stuff in the sides may be full or bare in thickness, and we want the bed to measure 5in. over the sides when roughly boxed up, the finished width being 4⅜in. Prepare pieces likewise for the bottom, *b, b, b, b, b,* and of the same width as the last, also the cross ribs, of the same width, too. Nail or screw all together. Plane up the sides to 4⅜in. wide at the bottom (bottom from the moulder's point of view, really the top face of the lathe-bed) by 5in. bare at the top. Plane over the face straight and square with vertical centre of the bed—i.e., so that the taper in the sides is equal relatively to the top; shape the blocks that form the swell round the gap, and plane 1/16th taper at the ends of the bed.

The main body is now ready to receive its equipments. Make a print 4ft. by 1¾in. by ⅜in. and nail it upon the centre of the face (Fig. 102). (In reference to the apparent discrepancy between the width of the print here given and the width of the groove in Fig. 100, as also to other instances of the same kind, as 5¼in. depth of bed in Fig. 102, against 5in. in Fig. 100, let me remark once for all, that these are the usual "planing" allowances. If the bed is to be filed up, less than half this amount will be sufficient). Extend the width of this print *just over the intended gap* to 4⅜in. (Fig. 103, Fig. 102, *c c*), the reason of which provision we shall see by and by. Prepare the outer V-shaped strips to the sections (Figs. 104, 105), and wire on in place, Fig. 102, *a a*. The outer lines in Figs. 104, 105, are the *pattern* lines, the inner ones represent the *planed* sizes. Make the fillet to section (Fig. 106), planing the straight portions, and cutting the curved parts round the gap with gouge and chisel, and nail or screw in place (Fig. 100, *a a*; Fig. 102, *b b*.) The strips D D D round the gap

Fig. 113.



Scale. 3 Ins – 1 Foot.

Fig. 112. Plan.

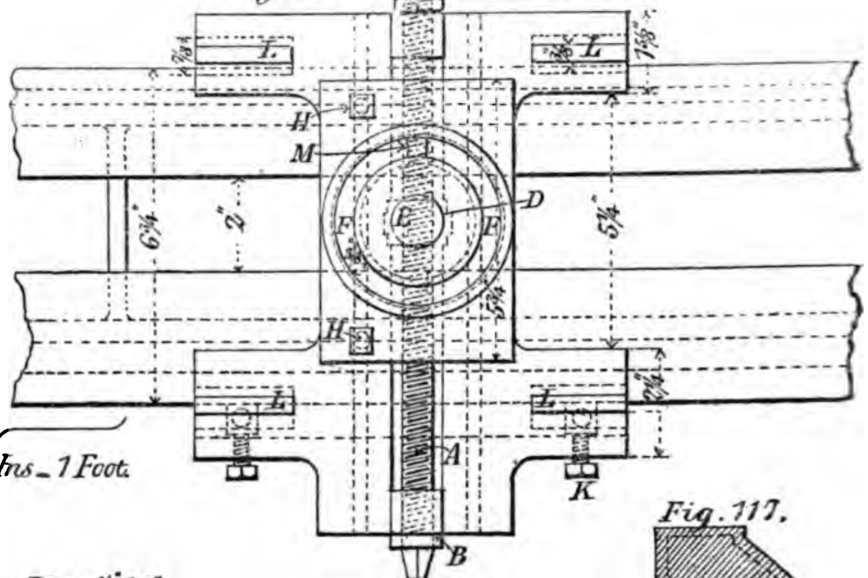
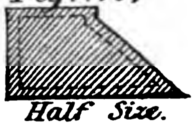


Fig. 117.



Half Size.

Fig. 115.

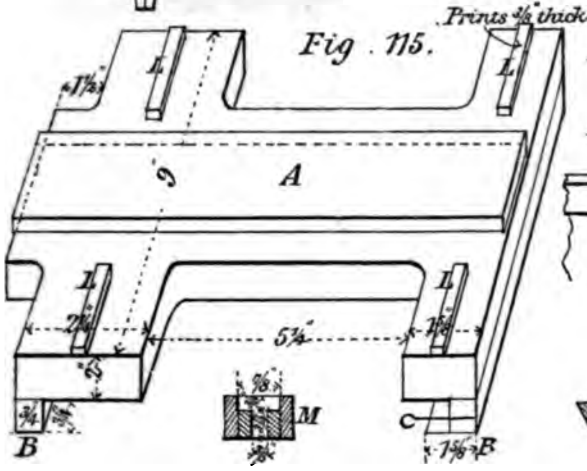
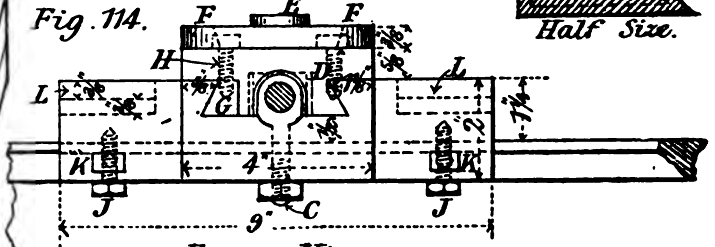


Fig. 114.



Front View.

Fig. 116.

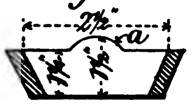


Fig. 119.

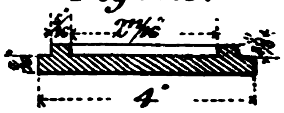


Fig. 121.

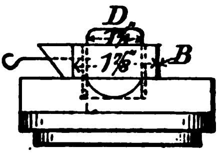


Fig. 118.

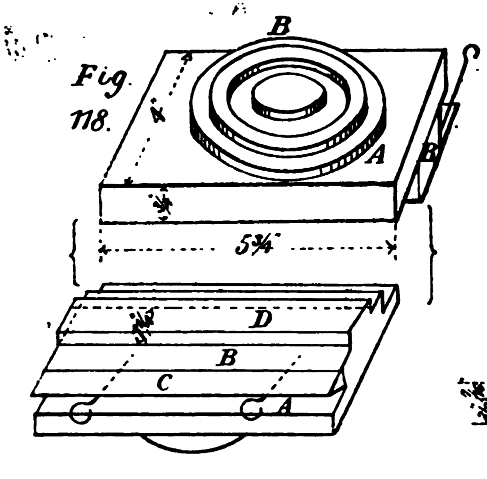


Fig. 120.

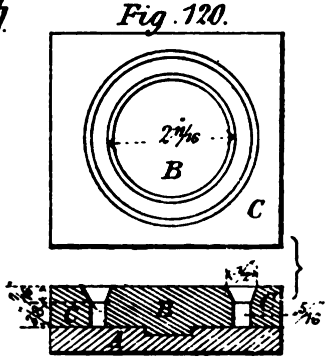


Fig. 123.

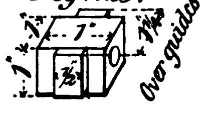
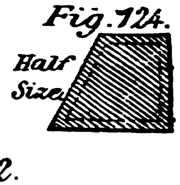
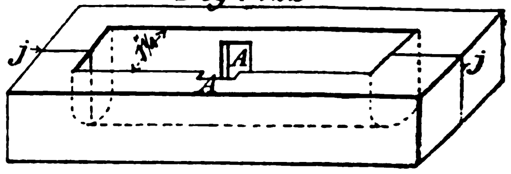


Fig. 124.



Half Size.

Fig. 122.



must, however, be wired on. The two facings for the standards 5½in. by 3⅜in. by ¼in (Fig. 100, *c c*), complete the pattern.

For the first core (Fig. 100, plan), frame up a box 1ft. 5½in. by 4in. by 5⅜in. (Fig. 107). This is long enough to include the first and second ribs, and deep enough to include the print. Plane two strips 1ft. 5½in. by 1⅜in. by 1⅛in., equalling respectively length of box, depth of inner strip and print, and width of inner strip with planing allowance, and screw them against the sides of this box flush with its top edge (Fig. 107, A A). Prepare two cross bars ¾in. thick to the shape and dimensions indicated in Fig. 108, which represents a section of the box, looking towards the end, and screw in place (Fig. 107, B B). Prepare a piece 4in. by 3in. by ¾in., and fasten at one end for the standard facing, Fig. 107, C.

The next box is framed to 1ft. 4½in. by 4in. by in., and one end is made to follow the outline *the pattern (Fig. 109).* In the end next the *cross-bar similar to the others,* but 3in. deeper, is fixed (B). The guide strips A A, for the headstocks, as in the last box, will be required. The box for the third core (Fig. 110) will be 8in. by 4 by 5⅝, having strips A A, cross-bars B B, and facing for standard C; or the second box may be utilised after its core is made, by screwing a cross-bar in 8in. from the end next the gap, and putting in the necessary parts.

The gap box (Fig. 111) is framed to 6in. by 4⅞in. by 8⅜in. This, it will be seen, corresponds with the print in Fig. 103. Against the sides of box screw two blocks 6in. by 5in. by 7/16in. (Fig. 111, *a a*), to form the metal at the sides of the bed below the gap.

The shape adopted for the bed just described permits the use of a better type of saddle than the one described for use with a wooden bed. The upper portion may, however, be still retained. The views are self-explanatory. It will be observed that no provision is made in the saddle for rack or screw traversing. To go into these matters would involve more than the scope of the present paper will admit of. But there would be no difficulty in providing either scr or rack motions for the lathe as far as the mod fication of the rest is concerned.

Fig. 112 shows the saddle and transverse sli in plan; Fig. 113 sideways; Fig. 114 in fro A is the screw; B the nuts attached to the sadd by the screws C C; D the nut held in the tran verse slide, through the medium of which t motion of the screw is communicated to the slid E the stud for the longitudinal slide; F F turned bevelled groove to receive the tightenin nuts for the upper slide; G loose strip for tran verse slide, tightened up by screws H H; I the loose strip for the saddle, fastened by screv J J, and *set* by screws K K; L L slots-f T-headed bolts, for convenience of holding wo to be bored.

Taking the pattern of the saddle first (Fi 115), make the main plate 2in. thick, to dimensio given, framing the parts together either wi half-lap joints or by mortises and tenons; on a print, A, ½in. thick, to take out the reco for the transverse slide; screw on the strips B

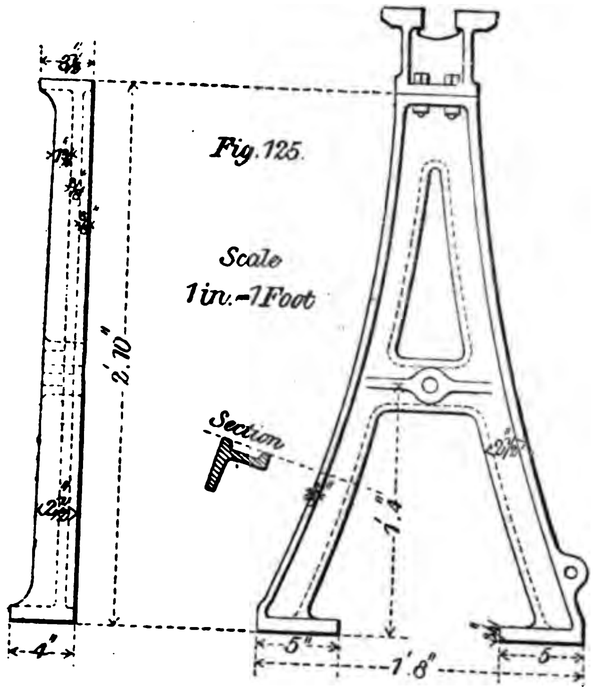


Fig. 125.

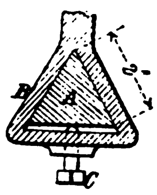


Fig. 127.

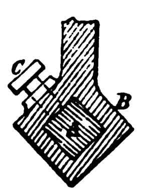


Fig. 128.

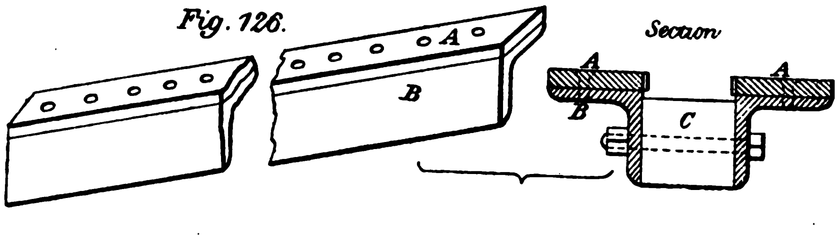


Fig. 126.

which embrace the lathe-bed, wiring on the Vee, which is cast in a piece with the saddle. Fig. 116 shows a section of the corebox, looking towards one end. By means of the curve *a* on the end cross bars of the box, the core is strickled to a corresponding shape for the purpose of taking out the recess underneath the traversing screw. The prints L L L L and their corebox M, shown in section, are for the ⊤-headed slots, shown in the three views of the rest. Fig. 117 is a half-size section of the loose Vee strip, I in Fig. 113, giving planing allowance.

Fig. 118 shows the pattern of the transverse slide, top and bottom faces respectively. The plate A is 5¾in. by 4in. by ¾in. (finished to ⅝in.) Upon this the circular face, with its print for the bolt recess B, Fig. 119, in section, is fastened. Fig. 120 shows the core box for this recess, in section and plan. A is a bottom board upon which a centre piece B is studded, and a ring piece, C, dowelled; the unshaded portion being the core space. Note that the width of core is given as $\frac{5}{16}$in. against ⅜in. width of groove on top of Fig. 112. This allows of the barest possible amount of skimming up in the lathe, the core being too small to permit of much turning allowance, neither is much necessary if the box be made truly. A slot will have to be cut in the casting, shown at M in Fig 112, through which to thrust the tightening bolts into place.

For the under face of the traversing slide prepare a piece of stuff 5¾in. by 1⅞in. by ¾in., and fasten on in the centre of the plate already prepared (Figs. 118, 121, B); on this wire the loose strip C, and nail the print D. Make core box (Fig. 122) jointed longitudinally, J J, and dowelled and recessed at sides A A, to receive the brass nut (Figs. 112, 113, D, and Fig. 123). The pattern for the loose strip G, Fig. 114, shown in section in Fig. 124, completes this part of the work.

The standard (Fig. 125) is suitably designed for the bed which we have described. The frame will be made with half-lap joints, and the ribs screwed upon it with $\frac{1}{16}$in. of taper on their inner faces. The ⅜in. ribs on the outer face simply relieve the heavy appearance of the casting.

Three forms of lathe-beds may be briefly noticed, which I have seen adopted. The first, Fig. 126, is made by riveting a piece of flat bar-iron, A, on a length of angle iron B, and planing or filing the face and the inner edge of the bar-iron true afterwards. Distance blocks, C, keep the cheeks duly apart. This is the best form of makeshift bed that I know of.

Another is simply a triangular bar of cast iron, Fig. 127A, planed or filed true, along which the poppet B slides, being tightened by the screw C. This answers for a light lathe.

The last consists of a bar of wrought iron, Fig. 128A, along which the poppet and rest slides, as in the last case. But the wrought-iron bar lacks rigidity, and the shape is not so well calculated to resist the shocks of turning work as the triangular form.

ON A NEW METHOD OF GENERATING ELECTRICITY.*

After referring to the researches of Deville and Troost, and the subsequent experiment of Graham on the penetration of hydrogen through red hot metals, the author describes experiments which he made with a view to constructing a voltaic cell in which occluded hydrogen should take the place of zinc. Cells were constructed by taking tubes of platinum foil, closed at one end, and connected with glass tubes by which hydrogen or other gases could be supplied to the interiors of the platinum tubes. Such a platinum tube could be held in the centre of an ordinary platinum crucible, which was intended for the other element of the cell. Various substances were fused in the platinum crucible at a red heat, and by connecting both the platinum tube and the crucible with a galvanometer by means of platinum wires any generation of electricity could be perceived. Several oxidising salts were tried without success, but by using glacial phosphoric acid at a red heat the author found a distinct production of electricity when hydrogen gas was conveyed into the platinum foil tube. The experiments being continued, it was found that a number of saline bodies in the fused state developed the electrical current with hydrogen, the chlorides of the alkaline and earth metals being quite as efficient as glacial phosphoric acid. It was found that the platinum tube containing hydrogen acted like a zinc plate in a voltaic cell, but it appeared that the hydrogen, after passing through the saline medium, also passed through the walls of the platinum crucible, and it was then oxidised. In order, therefore, to get good results it was necessary to maintain an oxidising atmosphere on the outside of the platinum crucible. A more perfect apparatus was subsequently made for carrying out these experiments, and by the use of this apparatus numerous substances were tested as to their transmitting capacities for hydrogen. Vitreous matters, such as glass, were found to make much better media than the alkaline chlorides. Even porcelain and earthenware were found to transmit hydrogen at a high temperature, under the peculiar conditions of the experiments. The use of glass as a medium made it possible to extend the researches in several directions, as oxidisable metals could be used in association with glass. The method usually adopted by the author was to take a glass tube of suitable quality, and to coat it internally with a metal, either in the form of sheet or as a pulverulent deposit. The glass was carefully fused on to this inner metal, whilst hydrogen was passed through the tube to prevent oxidation of the metal. Then the outside of the glass tube was usually covered with thin platinum foil. On connecting the inner and outer metals with a galvanometer and heating to redness, while hydrogen was supplied to the inside of the tube, the electrical phenomena were obtained with great facility. Nearly all metallic substances appear to be available for the internal coatings of these cells. These effects were easily reversible if a reducing flame was applied externally and air had access to the interior of the tube, as in this case hydrogen was supplied by the flame.

The quantity of electricity produced by this new method is proportionate to the amount of hydrogen diffusing through the apparatus; or, in other words, to the extent of metallic surface. The production of electricity also increases with the temperature. The electromotive force is, however, low. It was found by the author that the vitreous matters used for the cells were practically non-conductors of electricity of low tension if access of hydrogen was prevented, although they became good conductors when hydrogen was supplied.

The second part of the paper describes experiments in which the hydrogen in flames gives rise to electrical currents by acting on arrangements of glass and metal. A rod or wire of metal such as platinum or iron was covered with fused glass, and the glass was overlaid with platinum foil. On connecting the two metals with a galvanometer, and heating the cell in a flame, a current of electricity could be produced, which was due to the withdrawal of occluded hydrogen from the inner wire or rod by the action of an oxidising flame upon the platinum foil. Also a "reverse" current could afterwards be produced by the action of a reducing flame upon the platinum foil, hydrogen being then re-occluded by the inner metal. An experiment is also described in which a continuous flow of hydrogen was maintained through a cell having a fused vitreous medium by means of a Sprengel vacuum pump. In this case two concentric tubes of platinum were used, and the hydrogen was derived from a reducing flame, by which the apparatus was heated. The inner tube was connected to the Sprengel pump. By this apparatus a continuous current of electricity was produced. The author also describes some experiments which illlustrate the remarkable atomic force which hydrogen in flames exerts by reason of its great penetrative powers.

MADAN'S MODIFICATION OF DARKER'S SELENITE HOLDER.*

H. G. MADAN, of Eton College, has devised a modified form of selenite holder, which he finds preferable to the holder usually made.

The ordinary form of Darker's selenite substage fitting is well known; three films of selenite, giving retardations of ¼ wave, ¾ wave, and $\frac{5}{4}$ wave, respectively, are mounted in circular brass cells, which rotate in rings attached to a side arm, and can be thrown in and out of the field as required. This arrangement is perfectly effective, but it has two inconveniences: (1) that no means is provided for changing the films for others, such as Ackland's neutral tint film, or Klein's plate; (2) that when the selenites are in a position for use it is difficult to see, and impossible to tell by feeling, the exact azimuth of that direction in the crystal film, which is usually marked by opticians P A; i.e. the direction in which the retardation of one of the two rays behind the other is greatest, and which lies, of course, at an angle of 45° with the acute bisectrix, or "median line."

The arrangement described below is intended to avoid both these inconveniences.

The selenite films are mounted in cells of the shape shown in Fig. 1; a groove being cut in the edge of the cell before the handle A is soldered into its place. The holder is in the form of a ring, about 3-7ths of which are cut away, as shown in Fig. 2; the remaining part being quite sufficient to retain the cell in position, and yet allow it to rotate freely when it is "sprung" into its place.

Three of these holders are jointed to a side arm, so that they can be thrown in and out of use, as in the usual Darker's stage.

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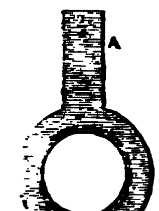
* Abstract of paper by J. A. Kendall, F.I.C., F.C.S., read before the Royal Society.

* *Journal* Royal Microscopical Society.

The handle A is made of such a breadth as to allow the selenite an angular movement in azimuth

Fig. 1.



of exactly 90°; which is, of course, sufficient for all modifications which it is capable of producing in a polarised ray.

Thus the various combinations of the films are obtained by merely moving the projecting handle 45° on either side of its central position—motions as simple and easy as those of a signalman in throwing over his levers for altering points and signals. In my own case, I have mounted the films in such a position that the acute bisectrix is in a line with the centre of the handle (Fig. 3). Hence, the plane of polarisation of the light being supposed vertical (i.e. at right angles to the length of a slide placed on the stage): (1) when the handles of the selenite holders are also vertical, the ray passes through the films without change; (2) When the handles are thrown 45° to the right hand, the maximum retardation due to the sum of the thicknesses of the films is produced: (3) When any one of the handles is thrown 45° to the left hand of its central position, the retardation due to that film is subtracted from that of the others.

Fig. 2.

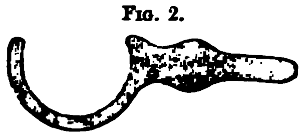
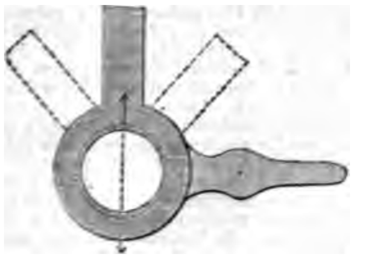


Fig. 3.



Thus it is easy to obtain any given retardation within the range of the series of films without removing the eye from the microscope. So, again, to obtain right-handed circular polarised light, the two thicker films are either thrown out of the field, or placed in the median position, and the handle of the ¼ wave film is thrown 45° to the right. To obtain left-handed polarised light it is thrown 45° to the left.

In my analyser cap a holder of somewhat similar construction is fitted for a single ¼-wave film, so that it is easy to analyse the light circularly, when desired.

If, for special purposes, an entire rotation of a film is desirable, it is only necessary to omit the handle, and mill the edges of the cell on either side of the central groove—in fact, I have several cells thus made. But I prefer the handle from its convenience in showing the exact optical position of the film.

I should like also just to call attention to the ease with which almost any microscope stand can be made to serve as a Nörremberg's polariscope for examining crystals under strongly convergent polarised light, in order to see the rings, &c., round the optic axis. All that is required is, to remove the nose of the main body, and screw into its place the usual system of converging lenses (which answers much better than any microscopic objective), the fourth lens of the system being fitted into the drawtube. A similar system of lenses is then fitted below the stage, in place of the condenser, and the crystal to be examined is placed on the stage; or, preferably, supported in a holder like Beck's opaque object holder, which allows it to be rotated.

Microscopes which, like Ross's newest pattern, have the fine adjustment separate from the main tube, and in which the stage can be swung to any angle, or removed altogether by simply loosening a screw, are especially adapted for the above fitting, since the upper lens system can be as large in diameter as the main tube.

The lenses I used were the ordinary "spectacle" lenses, including a pair of hemispheres, and the field is nearly as great as that of Hoffmann's instrument, just taking in the two axes of Brazilian topaz.

With such an arrangement, combined with the selenite stage, nearly or quite all the beautiful experiments given in Dr. Spottiswoode's little treatise on "Polarised Light," can be made.

It is more than a dozen years since I made the above addition to my microscope; and I am surprised that Nörremberg's lenses are not included among the usual "accessories" of (at any rate) first class microscopes.

A NEW THEORY OF LUNAR FORMATION.*

NOTICING the fact that there is a sequence in size in groups of craters, I was led to believe that this represented a sequence in time also. Hence I was led on from the inadequate explanations at present in vogue to believe that the rings are made of condensed vapour, snow, of a sort not necessarily exactly as ours, and that the solid ejecta piled to form the cones in the plain (beyond which the ejected favours fall) condensed as hail or snow, and circle, fountain wise, far beyond being in a vacuum.

Now, erosion is the great feature of our earth's surfacing, except at the poles, where the temperature is so low, and the surfacing is piled deposit. This struck me as the key to the surfacing on our moon. The general plan of surfacing is not cut out: it seems piled. Naturally, where there was neither air nor water (as such) a close study of this phenomena of piling up led me to wonder how it was done. It seemed to me self-evident that in such a group of deposited rings as Stofler (354 IV quadrant in Webb's map) the series in age or sequence and the series in size coincided to four places. In almost all other cases of interference, where one circle cuts another, the last is apparently always the smaller one.

Let us assume that the Moon and Earth are parts of one mass, and that the materials are not very dissimilar; that when separated each had a far larger atmosphere in proportion than we have now, and that from the far higher temperature the water was more or less suspended as steam or cloud. Now, as time passed on the moon cooled down to, through, and past the earth's present state. Then a time would come when we should see our polar and arctic phenomena, absence of life, and general similarity to what we see on the highest terrestrial elevations. At this time we should have simply a deposit of solidified snow, showing angular formation in places and in others the reverse, where the snow can lie for ages unchanged under a vertical tropical sun. In the case of the Himalayas it does so, the conditions necessary being bright above the snow line on a greatly attentuated vapour. We can further understand the gradual encroachment of the arctic icefields till they meet and case the earth in ice, below which in the oceans there would still be enormous reservoirs of water at 32°. The decreasing temperature would necessitate contraction of the globe, and the ice-shell would be ruptured, and large volumes of water emerge and flood the ice crust, level it, and being repeated it might gradually raise the level, and thus large raised flats may have been caused. Most of the lunar surface that we see is actually made of the lunar oceans, forced through a frozen solid surface and deposited outside till there was no more water or vapour to come out. The later ejections would only be able to melt a small cavity or crater hole, and pile the precipitated vapour close round. This would explain the otherwise difficult problem as to what becomes of the portions of rings effaced. They are melted away, and thus also the smaller circles may at times be the deeper ones. While the oldest of these circles is at the snow line, the second or smaller may have been formed below the snow line, but the deposit piled up to the snow line, and in the same way, as the cooling went on, the third, the smallest and deepest would be formed. In the case of large lunar rings the vapour rises from either an orifice or off a water basin that surrounds one, and the vapour is deposited in a circle around. If there were winds on the moon we should not see the deposit as a true ring, and if there was a steady and slow drift in an extremely rare atmosphere we should see elliptical craters. The objection that snow would appear as dazzling white is met by the fact that meteoric dust falls on our polar regions even in such a quantity as to be visible to the eye. Our snow is renewed, but the lunar snow is permanent. The long lines of tiny craters would be du to the vapour rising through faults. The concentric formation in the walls of the large walled craters is obviously a formation from a centre; it shows a formation from a centre as surely as the earth's polar ice-caps show the reverse—i.e., from a circle to a centre. The size of the walled plains seem to preclude the formation of a ring from solid rock ejected. They would seem more like frozen precipitated vapour, deposited while the contained sea was near and just below the line of perpetual ice.

In the second letter, speaking of the circularity, Mr. Peal says:—"It is traceable from the smallest craterlets to large ones, as Tycho, Copernicus, &c., from faint little rings laid as it were on a level surface, or larger, as Stadius, to great walled plains, with or without central cones, as Plato, Clavius, and still larger in S. Iridum, Mare Crisium, &c., and even the Mare Imbrium is like the S. Iridum, circular (though not complete); thus from the smallest to the largest the lunar features are circular. As regards the explosive theory, it seems incredible that in such craters or circles as *Plato*, Archimedes and Stadius that the explosions should result in such regular formations and leave the inclosed plain so destitute of signs. Again, such forms as the S. Iridum, Fracastorius, &c., are valuable on my theory. On looking at the moon with a low power, one cannot resist the conviction that the Mare Crisium is simply a larger instance of the S. Iridum or Plato; the greatest elevations are closest to the circle, and the surface descends thence downwards. The cause that formed the S. Iridum and Plato seems also to have formed the Mare Crisium. 1st, it is circular; 2nd, the inclosure is a plane on the surrounding material, is highest at or near the edge, and descends thence outwardly; the colour of the inclosure is different and darker than the surroundings. The mists seen at various times and by various observers may be the last trace of the action I have tried to depict."

In a third letter he explains that the forms of the S. Iridum, Fracastorius, &c., were caused by the removal of water and its deposit on land around, all that fell seaward being again remelted, and the piling could only thus take place landwards.

The theory explains:—

(1). The sea bottoms being apparently bare.
(2). The formation of S. Iridum and similar objects.
(3). The excavation and piling around of the matter removed from the cavity.
(4). The rings being concentric, and having several cones to one ring, and not a ring for each cone, as should be the case.
(5). That the later rings removed the water of the older where they interfere, and they are smaller and deeper.
(6). The evenness of the floor in many cases, since it is frozen lake surface.
(7). The craterlets being heat vents that melt out small cavities from which the moisture is removed and piled around, may form anywhere all over the ice-surface, and on the walls of the large rings, seldom seen on sea bottoms, though likely where any shallow sea is frozen.
(8). That as the energy slowly dies down, the heat is less, and the water and vapour forced through by contraction of the crust through cold, does not form a lakelet or crater, but is piled up in a lump or mound.
(9). That vents along a fault may cause a series of little craterlets, and that if the vents are small, moisture oozing will pile as a rule, either above the level of the fault opening or below it, and be bright since it is most modern, and it may, as a fault, pass through crater walls.
(10). That if there is sufficient inclination and time, the material may form glaciers, appearing like lava flows.
(11). That (most important of all) the whole phenomena form a series denoting expiring energy, and not violent and intense heat.

COAL GAS AS A LABOUR-SAVING AGENT IN MECHANICAL TRADES.*

By Thomas Fletcher, F.C.S.

GAS, as a fuel, is an absolute necessity to the economical carrying out of many commercial processes. It is often used in the crudest and most costly way. A burner may be perfect for one purpose, yet exceedingly wasteful for another, and however good it may be, an error of judgment in its application may lead to its total condemnation. An excess of chimney draught, in cases where a flue is necessary, may pull in sufficient excess of cold air to almost neutralise the whole power of the burner, unless a damper is used with judgment. With solid fuel, an excess of draught causes more fuel to be burnt, but with gas, the fuel is adjusted and limited; there is no margin or store of fuel ready to combine with the excess of air, which, therefore, by its cooling power, lowers the amount of work done. The power of any burner, for any specified purpose, depends not only on its perfection, but to a far greater extent on the difference in the temperature of the flame, and of the object to be heated. For instance, if a bright red heat is required, it is not possible to obtain this temperature economically with any burner working without an artificial blast of air, the difference between the temperature of the flame, and that of the object heated, is too little to enable the heat to be taken up freely or quickly, and the result is a large loss of costly fuel. If we want to obtain high temperatures economically, an artificial blast of air is necessary, and the heavier the pressure of air, the greater the economy. On the contrary, low temperatures and diffused heat are obtained best by flames without any artificial air supply.

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* By S. E. Peal, of Sibsagar, Assam. Communicated by the author to the Liverpool Astronomical Society.

* Extracted from a paper read before the Society of Arts.

For such purposes as ovens, disinfecting chambers, japanners' stoves, founders' core drying, and similar requirements, the best results are obtained by a number of separate jets of flame at the lowest part of the inclosed space, and the use of either illuminating or blue flames is a matter of no importance, as the total amount of heated air from either character of flame is the same. If there is any preference, it may be given to illuminating flames, as the proportion of radiant heat is greater, and this makes the average temperature of the inclosed space more equal; but, on the other hand, may be considered the greater liability of the very fine holes, necessary for illuminating flames, to be choked with dust and dirt. This may, to a great extent, be obviated by using very small union jets, and setting them horizontally, so as to make a flat horizontal sheet of flame. Burners placed this way are practically safe from the interference of falling dust or dirt, but not from splashes. Falling dirt or splashes must always be considered in the arrangement of any burners, and the ventilation must be no greater than is absolutely necessary for the required work. In cooking, this limit of ventilation may be exceeded, as most things are better cooked with a free ventilation, the extra cost of fuel being well compensated for by the better quality of the result.

Where an oven or drying chamber is used continuously, it should be jacketed with slag wool or boiler composition, but for many purposes this is no advantage. As an example both ways, I will instance the drying of founders' cores where there is only one blow per day. The cores of an ordinary foundary can be dried by gas in a common sheet-iron oven in about half an hour; any accumulation of heat after that time would be useless, and a jacketed oven would be of no advantage.

For the disinfection of clothes in vagrant wards and hospitals for infectious diseases, on the contrary, a continued heat is necessary, and in this case the accumulation of reserve heat, which takes place slowly in a jacketed oven, becomes of value, as the gas can be terned low or out, and the ventilators closed, insuring a more complete disinfection with a much smaller gas consumpton. Where an oven or heated chamber is much used for periods of over half an hour at once, a non-conducting casing pays well by reduced gas consumption.

For albumen and glue drying, leather enamelling, tobacco drying, and purposes where a large space has to be very slightly and equally warmed when the weather is unfavourable, steam pipes are generally used, but, not being always available, an exceedingly good arrangement may be made by placing at intervals in the room gas burners, of any construction, close to the floor, and surrounded with a sheet iron cylinder, say, 2ft. or 3ft. high. The tops of these cylinders must be connected throughout with a fairly large flue, which will take the products of combustion from the whole, and this flue must be carried either horizontally, or with a slight rise, so as to utilise all the waste heat. The reason for having a number of stoves at intervals is that the heat in a flue will not carry, for any useful purpose, more than about 8ft. or 10ft., and a stove would give an irregular temperature in any except a very small room. If all are not used at once, the flues of those not in use may be closed by a damper to prevent down draught. The use of hot-water pipes heated by gas may also be occasionally advisable, but, unless for some special reason, it is much more economical to use coal or coke, as the bulk of water makes an exceedingly good regulator, and makes a fire practically as steady and reliable as gas, thus superseding the more costly fuel.

For one of my own purposes I need hot-water pipes, having very little variation in temperature night and day, and using coke for economy's sake, I get a regular temperature by heating a large quantity of water, about 200 gallons, with the fire, and inclosing this in a tank jacketed with slag wool. My circulating pipes run from this tank, and a practically steady temperature, night and day, can be obtained with the most irregular firing, and occasional extinction of the fire for several hours at once.

For the heating of liquids, the greatest economy is to be obtained from one single flame, of as high a temperature as can conveniently be obtained, and the flame must be in actual contact with the vessel to be heated. In jacketing vessels, to prevent draughts, care must be taken that the jackets do not cause currents of cold air to rise rapidly up the sides of the vessel, and so cool it. If this is the case, the use of a jacket, instead of being an economy, is a positive expense, and waste of heat. Many processes, such as making oil and turpentine varnishes, require a heat under instant control, and in these, the use of gas is an important matter, as the loss and risk of fire are very serious elements of expense, more especially in small works where special and costly preparations for contingencies cannot be afforded. I have here, Fig. 1, a burner which, for its power, is, perhaps, the most compact, and gives the highest temperature of any burner yet known, and it is easily made in almost any size; it has, I think, many special advantages. The use of gauze, which is its only weak point, is more than compensated for by the very high duties obtained in practice with it, owing to the compactness and concentration of the heat obtained.

In such processes as the roasting of coffee, chicory, grain, &c., a diffused heat is necessary, but of much greater intensity than can be obtained with economy from heated air. In these cases the application of a direct flame is necessary, and it may be in actual contact with the substances to be heated, provided these are kept in constant and rapid motion.

The use of a revolving cylinder brings in complications with any burner which is supplied with gas at ordinary pressure without any artificial air supply, as the currents of air caused by the motion of the cylinder interfere with the satisfactory working of any burner, and the air supply must be either protected from draughts and irregular air currents, or the air must be applied artifically from some independent source. One exceedingly good way of making any burner work, independently of the currents caused by a revolving cylinder, is to apply the flame inside the cylinder at the centre, making the substances to be heated to fall in a continuous stream through the flame. This system is not applicable to fine powders, or sticky substances, as it necessitates the perforation of the cylinder, to allow of the escape of production of combustion.

For this class of work, a very concentrated heat is not desirable, as a rule, and a slit, or perforated, burner is preferable. Of this class of burner I have one which is not only new in its constructive details, but has great and special advantages for many purposes. It resembles a number of ordinary furnace bars (Fig. 2) with this difference, that each bar is a burner; in fact, it is an ordinary furnace grate, which supplies its own fuel. With the usual day pressure of gas, = 1in. of water, this burner will, at its maximum power, consume about 100 cubic feet of gas per hour, per square foot of burner surface, and as it can readily be made almost any form or size, its adaptability for a great number of uses is evident. I have made it in many sizes and shapes, to give flames from ½in. wide by 5ft. long, to large square or oblong blocks. By applying a blast of air at the ordinary gas jets, and supplying the gas by a separate pipe, or series of pipes, below the open end of the burner, this can be converted into a furnace of extraordinary power. It is quite possible to burn as much as 2,000 cubic feet of gas per hour, per square foot of burner surface, producing a heat sufficient to fuse any ordinary crucible. You see its power when I place a bundle of iron wire in the flame; it is, in fact, a concentration of hundreds or thousands of powerful blowpipe flames in one mass. It has also this advantage, that with a blast of air it will burn and work equally well any side up, and the flames can therefore be directed straight on their work without loss. It is, in one form or another, almost a universal burner, as it can be readily adapted to almost any purpose, from tempering a row of needles to making steam for a 200 horse-power steam-engine. It is easy to make, easy to manage, practically indestructible, and for commercial purposes, has, I think, a general adaptability which will bring it, in one form or another, into almost universal use. I may say that when we are in a special fix, this has in every case landed us out of the difficulty.

For heating large plates of metal equally, for drying paper impressions for stereotypers, hot pressing hosiery, crumpet baking, working up plastic masses which can only be worked hot, and work of this class, a number of separate flames equally diffused under the whole surface of the plate are necessary to equalise the heat, unless the plate is very thick, and these are better if produced by a mixture of gas and air, but in heating wide plates one difficulty must always be remembered, the burnt gases from the centre flames can only escape by passing over the outer flames, and therefore a space must be left between the top of the flame and the plate, or the outer flames will be smothered and make a most offensive smell.

In hosiery presses, bookbinders' arming presses, and many others, the top plate also requires to be heated. The best way to do this is to use a number of blowpipe flames directed downwards. In many cases the supply of air under pressure is a practical difficulty and objection. This is overcome, to a certain extent, by the use of a thick upper plate with a number of horizontal holes, into which a Bunsen flame is directed. In every case I have seen, without one single exception, the holes are either too small, or the burner is placed too close, and the consequence is that the gas, instead of burning inside the holes, as it should, passes through partially unburnt, and is consumed at the opposite end, where it is absolutely useless, the flame not being in contact with or under the surface to be heated, and therefore doing no work. In hosiery presses this is a great objection, as the holes are so long that an equal heat is simply impossible, and the only remedy is to use a blowpipe flame, which forces sufficient air in with the gas to insure combustion where the heat is necessary. The same remark applies to crape and embossing rollers.

Sometimes a plate is required to be heated to a high temperature in one confined spot, and, as an example of this, I may take the blueing of the hands of watches. For this purpose I have made several arrangements, and perhaps the best is a thin copper plate, bent down at one side to a right angle. In this angle underneath is directed a very fine blowpipe flame on one spot, and the hands are passed singly over this spot until the colour comes, when they are instantly pushed over the edge (Fig. 3.) For the blueing of clock hands a larger and more equally heated surface is required, and this can be obtained by a small powerful burner without a blast of air, using a rather thicker plate to equalise the heat. The same arrangement may be used with advantage for tempering small cutters for ornamental turning, pen-knife blades, &c., and in these cases the cooler part of the plate is of great value, as it enables the thicker parts to be slowly and equally heated up; the application of a mechanical arrangement to pass the articles to be heated, in a regular succession is a matter easily managed.

It is now a simple matter, owing to recent researches in the theory of heating burners, to obtain flames of any power without practical limit, which, without any artificial air supply, will do all which is necessary in this class of work, and the required arrangements are exceedingly simple.

We may now consider the heating of blanks for stamping, hardening the points of spindles, finishing the ends of umbrella tips, and work where a small article, or a small part of any article, has to be heated to a high temperature with speed and certainty. For these a long and narrow flame is necessary, and I may mention that in cases where a high speed of delivery is required, and a small part only has to be heated, such as, for instance, in the hardening of the points of spindles for cotton machinery, I have made burners giving a flame of exceedingly high temperature only ¼in. wide and 5ft. long. This flame is produced by the assistance of a blast of air, and is of sufficiently high temperature to fuse the spindle in a few minutes.

The points only project over the flame, and the spindles are carried mechanically at such a speed that at the end of the 5ft. traverse they are red-hot and drop into water. More than one hundred are in the flame at once, lying side by side.

For heating blanks for stamping, the furnace bar-burner (Fig. 4) is perfectly suited, and in this work the shoot supplying the blanks to the machine should be made of two fireclay sides, with an opening for the flame between the shoot and flame being placed at a sharp angle, to prevent risk of the blanks sticking or overriding each other. A blowpipe may also be used with good effect, as shown in Fig. 5, and in many cases it is preferable and much easier to manage.

In some cases the direct contact of the flame would spoil the articles to be heated, and instead of the arrangement mentioned a tube of iron, fireclay, or other suitable material is heated, and the articles are passed through it (Fig. 6). This system of continuous feed, through a tube, has been applied to the firing of small articles of pottery, and might possibly be well adapted, amongst other things, to the production of gas-burners.

Where the contact of air with the heated articles is injurious, many plans have been tried to keep the ends closed as much as possible, but I believe no more perfect and simple seal against the admission of air can be devised than to turn a jet of pure gas, unmixed with air, into each end of the tube. This is an absolute seal against the entry of oxygen in an uncombined state; free oxygen cannot exist at very high temperature in the presence of coal gas.

For many trades there is a demand for hardened and tempered steel wire, either round or flattened, and the production of this has led to many attempts to obtain a satisfactory continuous process. The common method now, which is worked as a "secret" process by most firms, is to pass the wire through a tube to heat it, as already described, and to run it direct from the tube through a hole in the side of a box filled with oil, the hole being packed with asbestos, to prevent leakage; from this it is passed through another similar hole on the opposite side, either over a plate heated to the right temperature or over a narrow open flame of sufficient length and power to give the correct heat for tempering.

Where absolute precision is necessary, the gas

Fig. 1.

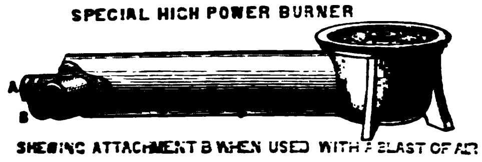

SPECIAL HIGH POWER BURNER
A
B
SHEWING ATTACHMENT B WHEN USED WITH A BLAST OF AIR

Fig. 2.

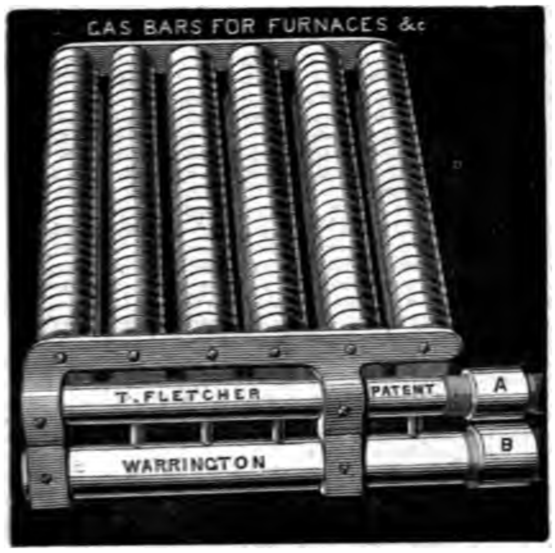


Fig. 3.

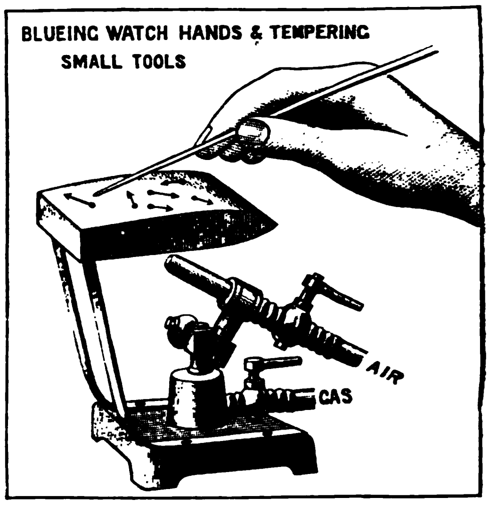


Fig. 4.

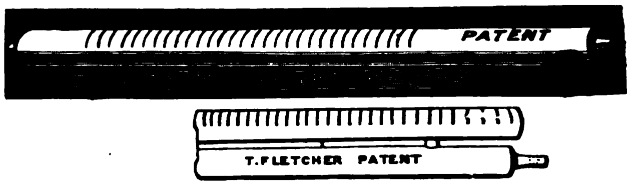


Fig. 5.

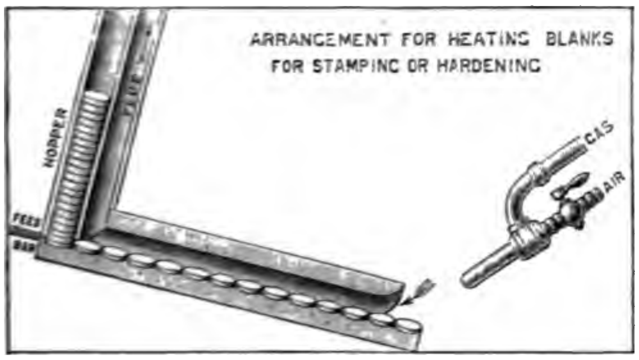
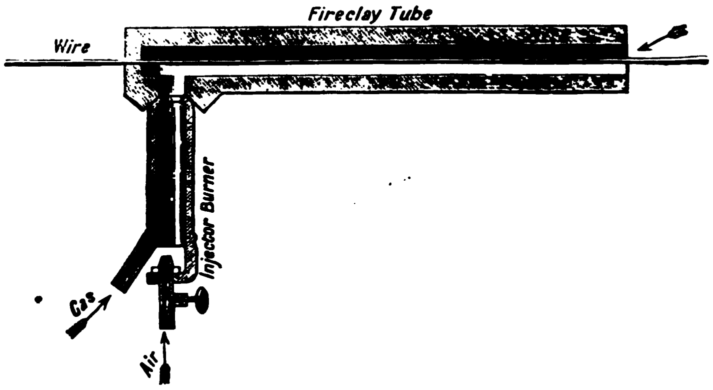


Fig. 6.



supply must be adapted by an automatic regulator on the main, to prevent the slightest variation of heat. Once adjusted, the production of flat and round spring wire by the mile is an exceedingly simple matter. It is quite possible to obtain absolute precision in temperature by a proper adjustment of the gas pressure, and as this is, for tempering steel articles and some other purposes, a matter of great importance, it is worth some consideration. No pressure regulator alone will give an absolutely steady supply; but if we put on first a regulator, adjusted to the minimum pressure of supply, say 1in. of water, and then fix another on the same pipe, adjusted to a slighly lower pressure, say $\frac{8}{10}$ths of an inch, the first regulator does the rough adjustment, and the second one will give an absolutely steady supply, providing always that the regulators are both capable of passing more gas than is likely to be ever required. No regulator can be relied on for absolute precision if worked up to its maximum possible capacity.

The thousands of uses to which blowpipes are adapted are so well known, that they need no mention, except the curiously ignored fact that the power of any blowpipe depends on the air pressure. A compact flame of high temperature cannot be obtained except with a heavy air pressure, and the ignorance of this fact has caused an immense number of unexplained failures. Many people think that one blower is as good as another, and expect that a fan giving a pressure equal to, say, the height of a 2in. column of water should do the same work as a blower giving the pressure ten to twenty times as great.

Since the conclusion of my experiments on the theoretical construction of burners I have found that the high-power burners, previously described, are capable of heating a crucible equal in size to *their own diameter to bright* redness without the *assistance of a chimney*, provided the crucible is *protected from daughts* by a fireclay cylinder.

This is an important point, as it renders the production of a continuous bright red heat a matter of the greatest ease, even in crucibles of a comparatively large size. Where the heat is steady, and certain not to rise above a definite point, it can safely be used for such purposes as hardening penknife blades and other articles which are very irregular in thickness, the thin edges not being liable to be burnt or damaged by over-heating.

For the highest temperatures air under pressure is a necessity, as we require a large quantity of gas burnt in as small a space as possible with the maximum speed, and, given this air supply, we are very little hampered by conditions, as an explosive mixture may be blown through a gauze into a fireclay chamber, closed, except so far as is necessary to allow the escape of burnt gases. The speed of combustion is limited only by the supply of air and gas, and increasing these these there is no practical limit to the heat which can be obtained. Where we have to do with the reduction of samples of refractory ores, testing the comparative fusibility of different samples of firebricks or alloys, &c., the use of an explosive mixture blown into and burning in a close chamber is invaluable, and the ease and certainly with which any temperature may be obtained has led to great discoveries, and the revolutionising of many commercial processes. Recent experiments have proved that by a modification in the form of the well-known injector furnace, an enormous increase of temperature may be obtained. I have, in actual work, obtained the fusing point of cast-iron in two minutes, starting all cold, and have fused every furnace casings I have yet been able to produce. If infusible casing can be made, I think I am not overstating facts in saying that any temperature required can and will eventually be obtained with the greatest ease. What the limit is I have as yet not been able to discover.

There is one more application of gas, as a fuel, which, discovered and published by myself some two years ago, has yet to become generally known, and in some special processes may prove exceeding valuable. This is the addition of a very sma quantity of coal gas, or light petroleum vapour to the air supplied by a blower or chimney pull furnaces burning coke or charcoal. The insta and great rise in temperature of the furnace, and th greater stability of the solid fuel used, are extra ordinary. This is, in fact, a practical application the well-known "flameless combustion," the on signs that the gas is being burnt being a great ri in temperature and a decreased consumption of th solid fuel; in fact, if the gas is in correct proportio the solid fuel remains unburnt, or nearly so, in sp of the high temperature. In cases where a sudd rise in temperature is required in a furnace, where the power is deficient, this method of supp menting and increasing the heat will be found very great service, and processes liable to checked by making up a fire with fresh fuel can carried on without check, even after the solid fu has almost entirely disappeared.

That a solid fuel is quite unnecessary I will pro in a very simple manner, by burning a mixtu of coal gas and air without a flame, in a bundle iron wire. The heat is sufficient to fuse the wroug iron with ease, and the glare inside the bundle wire is painful to the eyes. The same result cou be obtained by a pile of red-hot lumps of firebric and the same heat obtained also without a trace flame.

Of the special trades which have come under m observation I have only had time to mentio few. It appears to me that there are very f manufacturing processes of any kind which coul not be simplified by the use of gas as a fuel.

The first of the permanent caissons for the For Bridge, 70ft. in diameter, is now being put togeth on the beach, where it will be riveted up b hydraulic power, and then floated into position.

PIPES, GREEN SAND CORES, AND HOLLOW PIPE PATTERNS.*

THERE are few foundries that do not in some form make more or less pipes, and it is astonishing to note how much faster the same class of pipe work will be made in some shops than in others. This is mainly due to the difference in the facilities and rigging. In some shops a man may have to work harder to make one pipe than he would in others to make four, and as a general thing the shop that could turn out the four would require the least skill. Shops that produce such castings the slowest are, as a general thing, the ones that have the fewest to make, and therefore cannot afford the expense of getting up labour-saving rigging. There are times when a little outlay in some shops would be the cause of procuring much work, that in the end might result in the manufacture of a good paying specialty.

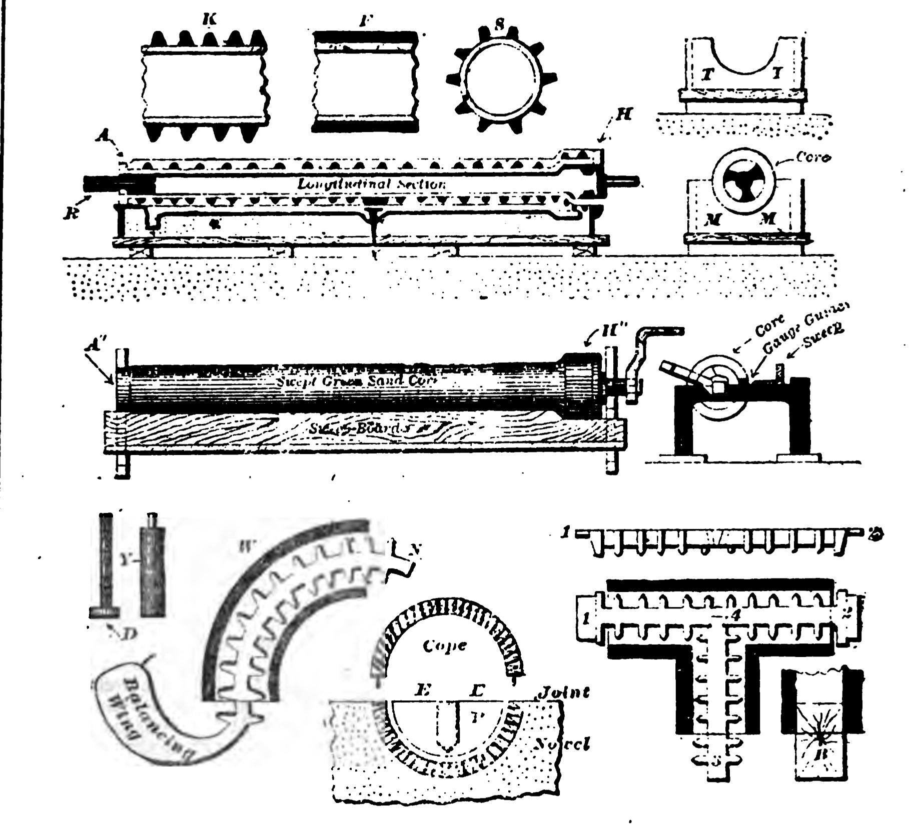
The general jobbing shop way is to make solid dried sand-pipe cores. The extra expense made thereby is the requiring of flour, and sometimes beer or molasses to mix with the sand. It also requires much labour to make them, fuel to dry them, and the loss of sand, and after all the time, labour, and expense we do not produce a perfect, round even core.

A plan practised in some shops that make a specialty of green sand-pipe castings is as illustrated in cut, showing the sweeping of a green sand core. This style of core is sure to produce a round hole, and with rigging properly gotten up one man can make a large number of cores in a day. The sizes of pipe generally made by this plan range from 3in. to 12in. In making the core arbors there are two plans adopted. One is to cast arbors having prickers, and the other ribs, upon their surface to assist in holding on the sand. To show what is meant by ribs, the sections F and S are given. At K, and in longitudinal sections of core, prickers are illustrated. As a general thing the ribs are used for the smaller sizes of arbors, on account of their making the arbors stiff, thereby preventing the core from springing up and shutting off the thickness of metal when the mould is poured.

The larger arbors are in diameter, the more resistance to springing they have when moulds are being poured, so that arbors over 5in. in diameter can generally be made stout enough without the ribs. For holding the sand prickers are to be preferred. The ribs, as it were, separate the sand into sections, whereas the prickers keep it together more in one body. The larger in diameter the longer can pipes be made. A foot pipe would be some 9ft. long; a 3in. pipe 4ft. long, and sizes between in proportion. Of course the stiffer arbors are made the longer they can be. Were chaplets used with this class of cores, as with dry sand cores, they could be made much longer. There is a way whereby chaplets can be used with some green-sand cores. That is to have a knob about 1in. in area cast or riveted to the arbor as above the chaplet X. This spot being even with the surface of core rests upon the chaplet, thereby causing iron and lead to come together. For the cope a small body of sand is taken out of the core and some small plates or washers inserted, the top surface of which had better be kept ⅛in. or so below the core surface. The space around these washers or nuts is then filled in and the core then made as smooth as the rest of its surface. Upon the top of the inserted pieces the cope chaplet rests. In so chapleting cores care is required, for should the chaplets come otherwheres than intended, the core would be bursted, and the casting, as well as the arbor, most likely lost. With such work exact measurement and fittings are required. With large diameter pipes there would be danger by thus chapleting of bursting the casting, on account of the knob X and the pieces above it, making a brace that would prevent shrinkage. Sometimes there is no danger of the core springing downwards, but there is a tendency to raise. When the lifting strain of the fluid iron comes upon it, in such cases as this, the bottom requiring no chaplet, the knob X could be upon the cope side, and the cores thereon be chapleted down, casting the pipe by having a chaplet only on the cope side.

The reason for using the washers or loose plates instead of a solid body being secured to the arbors, as above X, is to allow the arbor to free itself. Were the top the same as the bottom there would be immovable iron to iron. By having loose washers or plates the jarring of arbor soon causes it to be free, thereby letting it come out.

Core arbors should be well perforated with small holes, to allow the gases to escape. The thickness of sand upon arbors ranges from ⅜in. to 1in. The more nearly dry the sand used the better. In sweeping up a core, the process generally is to touch the arbor with clay wash or water, and after being set upon the horses the sweep board is set, sand is packed by hand upon the arbor, after which, with a man turning slowly, the sweep board is lightly pressed forward until it strikes the gauge guide which gives the diameter wanted. The arbor ends, A H, can be used to give the diameter, but having the core gagued independently of the arbor is to be preferred, as the friction of the turning will wear away the guide and also more or less vibrate the arbor, thereby often causing the sand to drop.



A point that here might be mentioned is that the less sleeking done to pipe cores the better. In fact, it is best not to sleek them at all, leaving the surface as it is swept, as the metal lays more kindly to the core.

In casting the larger sized pipes, it is essential that the arbors should have reliable bearings. 3in. up to 4in. pipes could be cast by having sand print bearings, but above this last size the arbor ends, A H, would be better if turned up true, so as to exactly fit the flask iron ends, as shown at M M. The cut T T shows the end without the core in. The arbors being true, the flask ends would of course require to be the same. By having arbors set in such bearings it is evident that the core will be kept central, and that its weight cannot sink it down, or the liquid iron raise it up; that is, as far as the prints are concerned. It might be well to mention that the pattern prints must fit into the flask ends when moulding the pipes, in order to have the mould central with the flask ends. In making arbors having such iron-end bearings, one, if not both, should be made smaller that the inside of intended pipe, so they may be readily got out of the castings.

The longitudinal section of mould shows a flange on one end and a socket on the other. This is only to illustrate the idea that either kind can be made. In the smaller sizes of pipe it is not necessary that the arbors should be larger at socket end, as shown at H. If the arbors are straight their entire length, and the sand reasonably tough, the little extra thickness required to form the socket will hang.

The plug seen at R is inserted for the purpose of lifting the core. Where arbors are large enough to admit a trunnion being riveted on, as seen opposite R, it is advisable to do so, as they can be revolved easier. Revolving arbors, by having their whole diameter turn in a bearing, as seeen at A, cause much friction.

The cuts of elbow and branch pipes illustrate the making of pipers with hollow patterns, they being the same as the castings wanted. At E E is shown a sectional view of the pattern. The nowel having been rammed up, the core arbor P is then set in and rammed up. The cope part of pattern is then set on, and sand tucked in. The joint having been made, the cope is rammed up, and after being lifted off the top pattern is drawn. By taking hold of the arbor handles, Nos. 1, 2 and 3, the core is lifted out; the bottom pattern is then drawn and the mould finished. The core is then set back and cope closed. The end of arbor at No. 3 is of a style different from Nos. 1 and 2. Arbors as at Nos. 1 and 2 are handy for small pipe. The arbor is set on the mould board, and the nowel half of the pattern over it, and the nowel is rammed up and turned over, the arbor forming its own print. This style is not recommended for heavy cores, as it does not give print enough to hold up very much weight.

The arbor as at No. 3 is of the same form outside the pattern as it is inside. To form prints for such arbors, with hollow patterns, there could be half round blocks, as shown at plan B, rammed up with the nowel half of pattern, and then when the nowel is rolled over draw out the blocks. This would leave prints formed ready to set in the arbors.

The quarter-turn pipe shows the plan of an arbor made so as to balance the core, the balancing wing projecting beyond the mould preventing the back, W, from sinking down as it would were both ends of arbor the same as at N and the back nut chapleted. This style of an arbor can, of course, be operated as regards rolling over and print making the same as the T arbor described.

At Y is shown a core rod and core made upon it. The head D admits of the core being lifted vertically, and also is a support to the core if rested upon its end. This class of green-sand cores can be used vertically or horizontally, and for pipes about 1ft. long, 2in. or 3in. in diameter, where their manufacture is to be made a specialty, they are worthy of consideration. The cores are rammed in a box endwise, and require to be vented, for which, in some cases, it might be well to have two or three vent holes drilled through the head D.

Green-sand cores, as a general thing, require more or less rigging, which is one reason why more shops do not use them. The holes formed by green-sand cores, as a general thing, for smoothness and being true, surpass those made by dry-sand cores, and generally thinner casting can be made with green-sand than with dry-sand cores. The making of green-sand cores often requires much skill. There are many cores being made of dry sand that could be made of green sand, but, like many other things in moulding, it often requires practical experience and good judgment to decide the feasibility of making them.

The Skrivanow Battery.—According to the *Electrician*, this battery, as used to supply current to the headlights of the ballet girls in *La Farandole*, at the Paris Opéra, is composed of the following elements:—A plate of zinc and chloride of silver wrapped in parchment paper, constitute the electrodes, and these are plunged in an alkaline electrolyte. The whole is inclosed in guttapercha cells. The size of the battery is 5 centimetres high, 6 centimetres wide, and 15 millimetres thick. The manner in which these batteries are fitted on the dancer is very ingenious. The cells used are arranged in the buckles of a girdle round the girl's waist, the real fastening being at the back. The wires are led round to the back, and then pass up under the hair to the ring which fits on the top of the head and carries the lamp and glass star.

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* By THOS. D. WEST in *American Machinist.*

SCIENTIFIC NEWS.

THE death of Professor Ernst Friedrich Wilhelm Klinkerfues, director of the Observatory at Göttingen, was briefly announced last week. He was born at Hofgiesmar, in Hesse Cassel, in 1827, and having been connected with the Göttingen Observatory for several years, he succeeded Gauss in 1856 as director. Prof. Klinkerfues was the discoverer of several comets, his first being III. of 1853, and his last [illegible]. He was a voluminous contributor to the *Astronomische Nachrichten*, and to other German periodicals, and will be also remembered as an inventor of several ingenious instruments. It is stated that pecuniary embarrassments were partly the cause of the rash act which terminated his existence. Prof. Klinkerfues was elected an Associate of the R.A.S. in 1882.

At a general meeting of the Royal Irish Academy held last week, a paper by Mr. J. E. Gore, F.R.A.S., was read. It contained a list of 190 variable stars, accompanied by an elaborate series of notes upon the more remarkable. The periods of most of the stars have been determined with an approach to accuracy. The communication was referred to the Council for publication. At the same meeting, Mr. W. De V. Kane, M.A., read a report on the Lepidoptera of the S. and S.W. coasts of Ireland. Prof. O'Reilly read a communication on the main lines of jointing observable about Dublin, in which he concluded that they clearly pointed to earthquake ruptures of the earth's crust.

Mr. Clement L. Wragge has, we understand, established himself near Adelaide, and has fitted up an observatory, where he will carry on certain planetary and solar work in conjunction with an elaborate record of meteorology. The telescope is a fine equatorial by Wray, having an aperture of 4½in. Mr. Wragge will have the help of a trained assistant to carry on the work in his absence.

Prof. Sir W. Thomson, who has been made a Knight of the Order Pour le Mérite for Science and Art by the Emperor of Germany, has, according to the American papers, accepted an invitation to deliver a course of lectures at the Johns Hopkins Observatory in October next.

Prof. Langley, of the Allegheny Observatory, has been interviewed by a reporter about the sunsets, and has expressed the opinion that there is not only no antecedent improbability that the volcanic eruptions were the cause, but that they are the most likely cause we can assign. Prof. C. A. Young, of Princeton, says that the volcanic theory seems to him to be the true explanation.

The fluctuations of the barometer, as observed at Edinburgh on Saturday, the 26th of January, appear to have been the most remarkable yet recorded for that neighbourhood. At 9 a.m. the barometer stood at 28·934, and fell steadily until at 10 p.m. it gave the remarkably low reading of 27·451, which is the lowest properly observed reading ever noted in Edinburgh.

During the gales of the 26th and 27th ult., unprecedented wind pressures were experienced at the Forth Bridge Works. According to Mr. B. Baker, M.I.C.E., the strongest gusts gave a momentary pressure of 35½lb. per square foot on the large board, 300 square feet area, and not less than 65lb. per square foot on the small board, containing 1·5 square feet.

On Monday last, Dr. T. Hudson delivered a lecture on "Rotifera" to the Midland Institute, Birmingham, in the course of which he stated that one very remarkable thing about them was that under certain conditions they could be dried and kept for three or four years, and could be brought to life again by moisture. The world of the Rotifera, said Dr. Hudson, is full of marvels, and they can be seen with microscopes of small power.

The Birmingham School Board propose to establish technical schools at a fee of 3d. per week. The course of study will run over two years, and will be taken up by those desirous of becoming skilled artisans who have passed the sixth standard. The curriculum will consist of elementary instruction in those sciences and arts upon which the trades and manufactures of Birmingham are based, and of practical training in the use of ordinary workshop tools.

In Liverpool, the "Acme" system of electric lighting is being tried. It consists of a primary battery, costing £50, which will give 20 lights of 20 candle-power during 46 hours. It is added that the cost of maintenance is "perhaps a little more than the price of gas."

According to Prof. Wanklyn, the manufacture of gas from limed coal (Cooper's patent) is a success, as it reduces the amount of sulphur compounds to three grains in the 100 cubic feet, and increases the yield of ammonia and tar by the abolition of the lime purifiers.

The Midland Railway Company has decided (upon the report of Mr. A. A. Langley) to key the rails *outside* instead of *inside*, as at present, the great reason for the change being the very large number of chairs annually broken. The company's locomotive committee has decided to paint the engines and tenders brown (the same colour as the carriages) instead of green; and it is under consideration to also paint the Pullman cars a similar colour: but upon this point the carriage and waggon committee has not yet finally settled.

According to the Patents Act of last year each applicant is required to make a declaration under an Act passed in 1835, and in the various articles upon the former Act which have from time to time appeared in the press, it has been stated that this declaration must be made before a magistrate. It appears, however, that notaries are empowered to take the declarations made under the Act of 1835. Mr. Wm. John Grey, Notary Public of Newcastle-upon-Tyne, communicated with the Board of Trade on the subject, and has received a letter stating that the declarations may be made either before a magistrate or a notary.

USEFUL AND SCIENTIFIC NOTES.

Natural Barometer.—The natives of the Chiloe Islands make use of a curious natural barometer, to which, from its having been first noticed by the captain of an Italian corvette, the name "Barometro Araucano" has been given. This novel weather guide was described at a recent meeting of the Linnean Society of New South Wales, as the shell of a crab, one of the *Anomura*, probably of the genus *Lithodes*. It is peculiarly sensitive to atmospheric changes, is nearly white in dry weather, but exhibits small red spots on the approach of moisture, and becomes completely red in the rainy season.

Gold Ink.—For making gold ink the following has been quoted in the *Chemist and Druggist*:—Take equal parts of iodide of potassium and acetate of lead; put them on a filter, and pour over them twenty times the quantity of warm distilled water. As the filtrate cools iodide of lead separates in golden scales. This is collected when the filtrate has quite cooled, washed with cold water on a filter, and rubbed up for an ink with a little mucilage. The ink thus made must be shaken every time it is used.

M. Chevreul.—After a service of more than half a century as director of the Gobelins Manufactory, this illustrious chemist has been placed on the retired list, and although in less than two years he will have completed 100 years of age, he considers that he has not been well treated. It would appear, however, that in order to spare the feelings of the old gentleman, he has been allowed to retain his appointment with the full salary attached to it. The Municipal Council of Paris has given his name to a new street in this city—an honour rarely conferred on persons while yet living. The following short account of his habits may be of some interest. He is generally lightly clad, and wears no hat unless under circumstances in which he is obliged to appear in one; indeed, he hardly needs a hat, as he has most luxuriant hair. He is constantly at work, allowing only ten minutes for each of his meals, of which he has but two a day. He breakfasts at seven, the repast consisting of a plate of meat and another of vegetables, which he eats together, the whole being washed down with two tumblers of water. He is said to have never drunk a glass of wine in his life. He dines at seven in the evening, and takes nothing between the two meals except a small loaf at noon, which he eats standing and by the side of his alembics. The writer who relates this states that on a visit to M. Chevreul he found him in the attitude just described, and on expressing his surprise at the frugal manner in which he lived, M. Chevreul observed: "I am very old (this was in 1871), and I have yet a great deal to do, so I do not wish to lose my time in eating." This example of longevity is certainly a good argument in favour of temperance and regularity of living.—*Lancet.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

MAGNITUDES OF STARS IN CASSIOPEIA, γ VIRGINIS, &c.—ASTRONOMICAL DIAGRAMS — SELENOGRAPHICAL — STANDARD STARS — ASTRONOMICAL WORK.

[22312.]—Some time since there was some discussion in the columns of the "E. M.," concerning the possibility of variability in β and ϵ Cassiopeiæ. I now forward a selelection from my observations of γ, β, δ, and ϵ Cassiopiæ. I have only included the most trustworthy.

Mon.	Day.	β	γ	δ	ϵ	Standard.		
1882.								
Feb.	16	—	2.4	—	—	α Pers.	= 2·1	
Mar.	12	2·6	2·4	3·2	3·8	α Ceph.	= 2·9	
,,	15	2·6	—	3·0	3·5	γ Cass.	= 2·4	Fine
,,	28	2·6	2·4	2·9	3·5	α Pers.	= 2·1	
Apl.	23	2·6	2·4	2·9	3·5	β Cass.	= 2·3	
,,	26	2·6	—	—	—	γ Cass.	= 2·4	Good
May	10	2·6	—	3·0	3·6	,, ,,	= ,,	Fine
,,	20	2·6	—	—	—	,, ,,	= ,,	Fine
Aug.	19	2·6	2·3	—	—	α Pers.	= 2·1	Splendid
Oct.	4	2·6	2·4	2·8	3·4	,, ,,	= ,,	Good
,,	19	2·6	—	3·0	3·2	γ Cass.	= 2·4	
,,	20	2·6	—	3·0	—	,, ,,	= ,,	Fine
Nov.	9	2·5	2·4	3·1	3·4	α Pers.	= 2·1	
,,	25	2·6	—	3·1	—	γ Cass.	= 2·4	
Dec.	20	2·5	2·3	3·1	3·5	α Pers.	= 2·1	
1883.								
Jan.	2	2·3	2·4	—	—	α Pers.	= 2·1	
Feb.	18	2·5	2·4	3·0	3·5	,, ,,	= 2·1	
Mar.	30	2·5	2·4	3·0	3·5	,, ,,	= 2·1	Fair
,,	31	2·5	—	3·0	3·5	γ Cass.	= 2·4	
July	28	2·65	2·4	2·9	3·6	Polaris	= 2·2	
Aug.	2	2·65	—	2·85	—	γ Cass.	= 2·4	
,,	22	2·6	—	2·75	—	,, ,,	= 2·4	
Sept.	5	2·6	2·4	2·8	3·5	Polaris	= 2·2	
Oct.	1	2·6	2·4	2·7	3·3	α Pers.	= 2·1	

I am not so sure about the observation of β upon January 2, 1883, as about the other observations. With this possible exception, the observations give no ground for the assumption of variability in β. As to ϵ, I think the variation shown is too great to be explained by the assumption of error. I would draw attention to the observations of δ. I have a strong suspicion that this star is variable to the extent of ·3 or ·4. Neither do the above observations reveal any variability in γ. If γ Cassiopeiæ be variable at all, it must, I think, be extremely irregular.

I must thank "H. S." for the information which, in letter 22120, he so kindly gives me. Concerning what he says about my comments, upon his saying that faint coarse pairs are not worth cataloguing—I may remark, that if these objects are not entered in catalogues of some kind, it is difficult to see how readily accessible and practically useful knowledge of them is to be preserved. I hope that some of those observers who pay attention to the variability of stars will remember to watch β 607 and Arg. (− 0°) 2600 occasionally.

The remarks which have been made in "ours" recently concerning the reproduction of astronomical sketches, suggests the inquiry whether no one among the numerous readers of the "E. M." will contribute to its pages an account of the best way of drawing and preparing such sketches for the engravers. I am sure that plenty of the readers of "ours" would be very much indebted.

In letter 22073 (p. 280) "M. A." takes notice of my remarks upon selenographical work in letter 22036 (page 239). Concerning his comments, I may say one thing—that while it is possible that I may have "a mistaken idea of selenographical work," it is certain that he has a mistaken idea of my meaning. I am not so foolish as to imagine, as "M. A." imagines I do, that "it is necessary to possess all the works of the great Selenographers in order to do useful lunar work." My objection to the introduction of much technicality into selenography, is not that it renders it difficult to "grasp easily," but that it is the tendency of technicality to render science hard, dry, and uninviting, just as it is the tendency of specialism to hinder the attaining of a just and broad view, and to render the specialist apt to put an undue value upon details. But technicalities and specialism, alike, are almost certain to have one result—a result destructive of the interest felt by the amateur—they are almost certain to destroy imaginative pleasure. How "M.A." can say that I "certainly have a mistaken idea of the use of the District Catalogues" when I made no mention of my ideas upon the subject, puzzles me. I said that they are "unsatisfactory substitutes" for Mr. Birt's papers—and so they are. But that does not affect the fact that they are of great value, for *their specific purpose*. But the mere fact that they are dry lists of objects, position angles, and relative distances, put together for one definite end, deprives them of all power to stimulate the imagination—whether to the better realisation of existing knowledge, or to the conception of other ways of acquiring new. I could have wished that "M. A." had stated his own "idea of selenographical work." The "lunar work," which, he says, the District Catalogues "will be found to simplify," can only be work in *one* of the various branches into which selenographical and selenological work will be found to divide. The confirmation or disproof of the existence of objects already registered and the discovery of new ones, are not the only pieces of work which may be undertaken. It is a pity that no one now contributes to the "E. M." notes as to what definite information is wanted concerning definite objects. Will Mr. Elger contribute notes of this kind? They would differ from his extremely valuable "Selenographical Notes" in the *Astronomical Register*, in not being so much records and discussions of work done, as hints and guides as to work which should be done.

Perhaps the most important at present among the various objects of lunar study are the *Light Rays, Spots, and Streaks*. It may, perhaps, be well if I here quote a passage from a letter written by Mr. A. Stanley Williams to the *Astronomical Register* in December, 1882. That excellent observer (concerning whom I may say that many must regret, as I do, his almost complete disappearance from these pages) expressed himself thus:—"It is a singular circumstance that the lunar light-streaks, which form one of the most extensive classes of objects visible on the moon's surface, have, up to the present time, nearly entirely escaped attention. Observers have spent the greater part of their lives in recording the numerous craters and mountains visible on the lunar surface, but have scarcely bestowed more than a passing glance upon this important class of objects. It is more unaccountable because their features are probably better suited than any other to reveal *real* changes which may take place, and are also particularly well suited to afford evidence of the presence of an atmosphere. There are but very few formations which have been studied sufficiently well to give even the more prominent light markings, whilst those which have been subjected to what may be considered a fairly exhaustive examination, amount to only three or four. In all the last-mentioned cases, it may be remarked, considerable changes have been seen to take place, due, perhaps, in great measure to the presence of a lunar atmosphere, and it is certain that an observer who diligently studies these features, even with an instrument not exceeding two inches in aperture, may expect an abundant harvest of valuable results." So far as my limited experience in the observation of these objects goes, it fully bears out the truth of Mr. Williams' remarks. I have principally observed the ray-system of Proclus. Concerning this system, I would make one remark—either the difficulty of seeing the rays has been overrated, or they have increased in brightness. Mr. Webb says (following, I suppose, Beer and Mädler) "It is the centre of several bright streaks, not very easily seen." And in a back volume of the "E.M.," "F.R.A.S.," in giving *lunar tests* for a 3¼in. refractor, says, "He may also try, under suitable illuminations, to make out the system of light-streaks round Proclus." My experience has been different. Not only do I find the principal rays *easy* with my 3¼; but I see them from shortly after sunrise to shortly before sunset. I see a good deal of the detail also, and have little doubt that, with favourable weather, I may be able to complete a map of the system. I have been using Dennet's map (given in the "E. M." for September 5, 1879) for reference. I have confirmed the existence of most of his rays; but attribute them, in several instances, to other centres of origin. As far as I can make out, Dennet's ray IX. issues, not—as he makes it do—from the same centre as his I., but from the same centre as his VIII. In regard to Dennet's IX. (indeed, I think in regard to some more of the rays) I have made a curious observation, and one which bears upon what Mr. Williams, in the above extract, says concerning the possibility of detecting signs of obscurations by means of observation upon the rays, IX. ends a little to S.E. of Cleomedes F. Just within the E. border of the Mare there is a *white spot* upon the ray. Between Cleomedes F. and this white spot the ray seems always to be of the same degree of brightness and distinctness; but between the white spot and the origin, the ray is at some times much fainter than at others. The rays seem to me to be of different classes; some being narrow and definite, and others diffuse and cloud-like. I have sometimes wondered why Mr. Birt's excellent classification of the Rays into Tychonic, Copernican, and such as might be similar to the "comet-tail" of Messier, has not been generally adopted.

In regard to what "M. A." says about my sketches in letter 22036, p. 239, I may say that, in in that of Plato, it is quite possible that the object I conjectured might be Schröter's χ may be placed a little too far east. As to his remark that "the ridges B in his sketch, between Picard and Pierce, may be the same as that mentioned in 'Lunar Work' in the *Astro. Register* for Feb., 1883," I would like to know *which* of the ridges there mentioned he means? So far as I can make out, all the observations by Miss Ashley reported there have reference, with one exception, to the different portions of Schröter's forked ridge. But my ridges B can hardly form any part of that object, for they lie either *between* Picard and Pierce, or *east* of the line joining them. It is stated (*loc. cit.*) that on Aug. 1, 1882, at 14h., Miss Ashley saw a low ridge connecting Picard and Pierce. (Aperture and power are not stated.) This observation might bear upon the identification of my western ridge B, but cannot upon the eastern. But I did not see anything like a connection between the extremities of the western ridge with the walls of either ring-plain.

I must now answer "Stella," who put to me upon p. 351 a query (52516) concerning "Standard Stars," and before replying, allow me to request "Stella," not to consider me dilatory and discourteous. The usual way of selecting magnitudes for standard stars seems to be to take the magnitude given by Heis, and express it decimally. I do not specially admire this plan, principally for the reason that it is putting a definite value upon what is avowedly *indefinite*; but if standards are to be taken from Heis they are better to be selected from among those stars, his estimates of which are identical with those of Argelander. For myself, I prefer following the "vulgar" magnitudes in Sir John Herschel's table of "Vulgar" and "Photometric" magnitudes. Here are some from Heis and Argelander:—1·0, Aldebaran, Spica, Rigel; 1·3, Regulus, Altair; 1·7, α Cygni, Castor; 2·0, β Tauri, β Ceti, β Leonis; 2·3, γ Urs. Maj., β Herc.; 2·7, η Canis, κ Orion, ε Cygni; 3·0, ζ Leonis, θ Urs. Maj., β Can. Min.; 3·3, ζ Tauri, ν Urs. Maj., λ Orionis; 3·7, ο Leonis, β Cancri, η Aurigæ; 4·0, ν Persei, π And., τ Orionis; 4·3, δ Urs. Min., 10 Tauri, γ Trianguli; 4·7, χ^1 Orionis, κ Aurigæ, 88 Tauri; 5·0, ρ Orionis, 26 Urs. maj., λ Arietis; 5·3, 97 Tauri, η Arietis, φ Aurigæ; 5·7, μ Aurigæ, 93 Tauri, π Arietis; 6·0, χ^3 Orionis, 68 Virginis, 114 Tauri. As to my own observation, Procyon is the only star which I feel pretty sure is exactly 1·0. Sir John Herschel gives Vega and Capella as being also 1·0; but I rather think they are one or two tenths brighter. They are, however, difficult to compare. I know of no star *exactly* 1·5; but I find Pollux 1·4. Flammarion makes Altair 1·5. I find α Andromedæ, γ Orionis, and α Ophiuchi constant at 2·0. α Persei I estimate at 2·1, and Polaris at 2·2; and I find these stars the best of all standards. I make β Aurigæ and α Arietis, 2·3; and β And. 2·4, and γ And. 2·7; but I know no star exactly 2·5. 3·0, η Draconis, α Cephei, and β Arietis. 3·1, β Draconis and γ Urs. Min.; 3·2, η Boötis; 3·3, δ Draconis, and α Can. Ven.; 3·4, γ Lyræ (this star is entered in Messrs. Espin, Gage, and Read's Catalogue, but I altogether doubt it being variable); 3·5, α Draconis, λ Tauri, γ Ceti; 4·0, ν Cygni, ζ Cephei, λ Boötis; 4·2, κ Cass.; 4·3, κ Cephei; 4·5, 5 Tauri, 35 Arietis; 5·0, φ and 50 Boötis, σ and 50 Draconis. I hope that these lists will help "Stella," and will be willing to help him further if I can.

I was very glad to see the letter on p. 301, signed "Orion," on "Specialism in Astronomy." I only differ from the writer in thinking that astronomy is not only "one of the," but *the* "most interesting and attractive of the sciences." How many agree with us both, your invaluable pages, Sir, amply attest. But large as is the amount of work done, much more *might* be done. "Orion" speaks of "'common' work, which may be done with the naked eye, or with optical means at the command of almost anyone." This is literally true. Much may be done, even if the observer have nothing else to work with but his unassisted vision; and much more may be done if he have an opera-glass to help him. I have paid a good deal of attention to the matter, and speak from personal experience. But this "common" work stands in need of classification. In a private letter, "Orion" remarks, "it should be remembered that many, who study astronomy for pleasure, would be glad to do a little work on subjects which lie, as I may say, at hand, but would have a most decided objection to go into recondite details. But," he continues, with perfect truth, "if these subjects are not brought before their eyes, they are not likely to trouble themselves in the matter."

Will Prebendary Webb, Mr. Franks, "F.R.A.S.," Mr. Espin, and Mr. Denning give their aid and encouragement? More especially would I like from Prebendary Webb and Mr. Franks some advice on the observations of star-colours, and particularly with regard to the degree of success with which they can be conducted with naked eye and opera-glass. Another remark I would make is this: it is commonly overlooked that a good deal of elementary astronomy can be properly learned, and a good deal more properly comprehended and realised, by naked-eye study alone.

S. Maitland Baird Gemmill.

Glasgow.

PONS-BROOKS.

[22313.]—I notice the inquiry in regard to the brightness of comet Pons-Brooks in letter 22218, p. 408. I beg to say that I have been trying to compare its brightness with the stars upon Heis' New Atlas, ever since it became certainly visible to my unaided eye on Dec. 15th. On that date and on the 16th, I strongly suspected it was the comet; but on the 17th I became positive of it, and could pick it up with the naked eye before setting the telescope.

My comparisons commence on the 17th, at which time its brightness was estimated as fully equal to either of the two stars b^2 and b^3 Cygni, and somewhat brighter than one of them, and I believe that, with perhaps one or two exceptions, the observations were carried on upon every clear night since that date. At first, when it appeared merely like a faint star, there was not much difficulty in comparing it with neighbouring stars; but when it began to assume a hazy and cometary look, I experienced some trouble in trying to assign its approximate brightness. It would catch my eye perhaps as soon as some definite star; but when I came to compare them critically, the intrinsic brightness of the star was so much in excess that it was difficult for me to satisfy myself. Still, by looking up suddenly and noting what objects caught my eye at same time, then noting which was the comet and comparing it sideways with the star and then running my eye rapidly from one to the other, —by keeping this up for some time I think I got about as near to it as it was possible for a fellow who was trying the matter for the first time.

The following are selected from my observing-book:—

Jan. 9th.—Just about equal to Zeta Pegasi; sometimes with averted vision suspect it as slightly brighter. Slightly brighter than Mu, but decidedly not as bright as Eta Peg., and Epsilon Peg. still much brighter than comet. Suspect at times a faint trace of tail not more than ¼°, but it always vanishes with steady gazing. A spell of cloudy weather then set in, and comet could not be seen until—

Jan. 13.—Almost equal to Alpha Peg., sometimes suspected as fully equal to it; certainly somewhat brighter than Gamma Peg., but not as bright as Alpha Androm. (There is something wrong here in my estimate, as Heis has both of these stars as 2nd mag.; but that is the way it went down in my note-book before referring to the Catalogue.) Looks like a star with only a small trace of nebulosity. Can't say that I see any tail, except at times a faint trace by averted vision, but short at that. Disappointed about tail, but nucleus is much brighter than when last seen, and much brighter than expected by me. (The moon was up, but behind a heavy bank of clouds in the east, and did not come out for five minutes or more.)

Another spell then set in, and comet could not be seen until

Jan. 17th.—Tail much easier seen than expected. Pretty plain for 3° or 4° or so, and think that when seen sideways several degrees longer—possibly 6° or 7° total. Hard to estimate this, as unused to such distances. (When I came down I marked position of comet on the atlas, and by comparing its distance from the stars Beta and Eta Ceti, found that its suspected length was well on to 10° or so. It was only bright and evident for 3° or so, and balance was faint and seen only sideways. Still, I think it was faintly visible at times to that length.) Nucleus pretty plain, not as bright as Beta Ceti, but nearly equal to Gamma Peg., brighter than Eta or Theta Ceti. Tail seems pretty straight, and spreads (afterwards, through the telescope, the tail I thought appeared slightly curved). Nucleus and head did not strike me as being as bright as on 13th.

The above are all naked-eye observations. It will be seen that at the very time its calculated brightness was greatest, it was invisible here; but I suppose plenty of your readers saw it at that time. I should judge that when at its brightest, it was fully equal to a 2nd mag. star. Did it not therefore exceed its calculated brightness somewhat?

I would also like to ask whether any of your observers noticed anything peculiar in the appearance of the comet's nucleus and head on the night of Jan. 13th – that is through the telescope.? I was observing it with my 4in. equatorial by Cooke, of York, and with a comet eyepiece, p. 25, at about 7h. 30m., 75th meridian time. The following abstract is from my observing book:—

A strange change in nucleus or coma. Never saw it look this way before. A *sharp* and *distinct* stellar point, surrounded by a bright almost circular nebulosity, and then outside of this the regular faint coma. The stellar point small, and brighter than the circular nebulosity, and perfectly distinct from it. The circular nebulosity somewhat fainter, but perfectly distinct from the coma, and the coma faint and indefinite; three grades as it were. I estimate the *diameter* of the bright circular nebulosity as about 1', by a rough comparison with the companion of Delta Orionis.

On the 17th, when next seen, nothing like the bright circle could be seen. Nucleus was strongly condensed, but the sharp and distinct stellar point in centre was not visible, nor have I ever seen anything like the same appearance since.

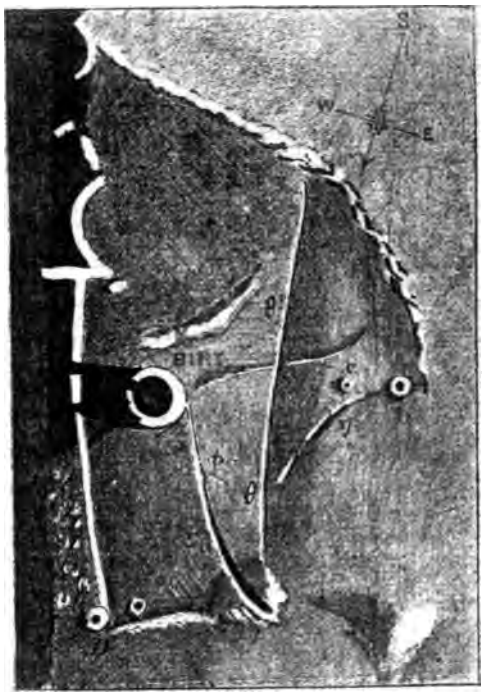
At the risk of being "sat down upon," and placed in the category of those gifted with vision bordering on the miraculous, I send you this account of appearance of comet on the night of Jan. 13th. It seemed to me like a strange change, and was so sharp and obvious that it caught my notice as soon as I looked into the eyepiece. At 7h. 20m. the moon was out of the clouds in the east, and with comet eyepiece "the tail could be seen about 1¼° pretty plain, and perhaps 1½°, but after that uncertain."

In regard to the naked-eye estimates above, I used only the Atlas of Heis in identifying comparison stars, and after making notes and coming down from Observatory, referred to his Catalogue, where the magnitudes were subdivided closer. Sometimes I found my estimates agreeing very well with him, and sometimes I found myself "off," as, for instance, for some cause or other, Tau Cygni always seemed somewhat brighter to me than Nu, although both are 4th mag. in the Catalogue. **W. H. Hennesay.**

Baltimore, U.S.A., Jan. 22.

SELENOGRAPHICAL—BIRT—MESSALA

[22314.]—"M. A.," in his interesting communication (22238), relating to clefts observed by him on 24th November, 1880, in the neighbourhood of Birt, describes and draws a long straight cleft extending in a southerly direction from a conspicuous hill on the north of Birt to the range of ridges on the east and south of it, and refers to an observation of my own which, as the inclosed sketch will show, was made under a very similar angle of evening illumination. The date of my drawing is 23rd October, 1883, 17h. to 18h. 10m. On that occasion two clefts were visible, one marked ϕ, and the other θ. The former was traced from the foot of the eastern wall of Birt to the hill (1) into which it cuts, as shown. The latter (θ) appears to originate at the same hill, and runs in a southerly direction at the bottom of a shallow valley till it encounters the *ridges on the south*-east of Birt, beyond which it was *not seen. I think there* can be no doubt that the cleft marked ϕ in my drawing is the prominent cleft shown by Schmidt and Neison almost precisely as I have drawn it—the southern continuation of which (ζ) is so rarely seen. If this be so, the cleft shown by "M. A.," passing some distance to the east of Birt, and terminating at the above-mentioned ridges, must be that marked θ in my sketch, and not ζ, as "M. A." supposes. I have many drawings showing the cleft ϕ, which is always seen terminating apparently close under the foot of the east wall of Birt, and I invariably find it a far easier feature than θ. On the same day, 23rd Oct., 1883, I noted a very delicate cleft (η) extending from θ towards craterlet *b*.



Messala.—With respect to the semicircular ridge observed by "M. A." outside the east wall of Messala, corresponding to a similar object in the interior of this formation, I may say that a drawing made at 11h. on 18th September, 1883, shows this feature very distinctly, and from "M. A.'s" description doubtless agrees very well with his own observation. **Thos. Gwyn Elger.**

Kempston, Beds, 29th January, 1884.

GLASS DISCS FOR REFLECTORS.

[22315.]—In answer to "Caplatzi" (22308), I most willingly give the result of my experiments on the safe thickness of glass specula, and it just amounts to this, that to be perfectly free from danger from flexure with the ordinary usage of the amateur, the speculum ought to be no more in diameter than six times its thickness; and even then, I should not say carelessness in the mode of support on the machine while polishing and figuring, or carelessness in mounting in the telescope, would go unpunished, though I believe it is possible to make a speculum free from flexure, whose diameter is twelve times its thickness, for I have done so myself, and I think there is no difficulty in it to one who is aware where the important points lie to be attended to. These, I think, I have pretty well ventilated in my letters on the grinding and polishing of glass specula, and, perhaps, now that the attention of amateurs is called to the importance of avoiding flexure, they will be more careful in the future; in which case I should say it would be safe to cut "Caplatzi's" glass into discs up to nine times their thickness. It is well for all to remember into what ratio the strength increases with the thickness. It is the square of the thickness that gives the ratio; thus a speculum twice the thickness of another is four times its strength in resisting flexure, and a speculum in diameter nine times its own thickness, would be about double the strength of another in diameter twelve times its own thickness.

The best way I know of getting the glass cut up into discs is to get it cut up into squares the size, or a little larger, say ¼in., than the discs I require. This would be done at the shops or works where they sell such glass. I should then take these squares to glassworks where glass cutting is carried on (and I believe there are several in London), I should get the corners cut or nipped off, and the whole rounded on the glasscutter's wheel; this they can do very nicely if they like, and the disc will then require no grinding of its edges by the amateur. This will save a lot of trouble; and further, while at the glasscutter's shop, the surface (the rougher one) had better be hollowed out to a gauge of the curve, the radius of which is about eighteen times the diameter of the disc; the amateur will then be able to make it what focus he likes, the rough work having been done for him. This will save him a lot of trouble, if the glasscutters are careful, for they cut the glass away on a wheel with sand, and not on a tool like the amateur; and, therefore, the importance of a gauge that tests two diameters at once at right angles to each other. This gauge I have drawn and described in Vol. XXXIII. p. 621. This mode of procedure I find the readiest, since I live within a short distance from glasshouses and glasscutters. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

[22316.]—I should not advise Mr. Caplatzi to cut his squares of glass (1¼in. thick) into discs larger than 8½in. diameter. I think he is wrong respecting the rigidity of cast and rolled or plate glass. I have tested the two by equal uneven supports of the mirrors, and found *less flexure* in the cast ones. The crystallisation, *if I may so term* it, of the cast glass is not disturbed by the *rolling*, which is necessary in making plate. Something analogous might be said of a cast-iron plate and a rolled one: though the material is not exactly the same, the cast one would certainly be the most rigid.

My 12½in. discs (cast) are 1⅝in. thick, and require a fortnight annealing. I should think he might safely cut his glass up into 5½in., 6½in., and 8½in. discs, and employ the rotating ring, as the diamond, hammer, and pincers process is only a risky one, and the edges would require grinding.

W. S. Scott, Southwick, Sunderland.

PARAFFIN LAMPS AND BURNERS.

[22317.]—Having had a good deal of experience in the use of paraffin lamps, I can inform "Os" (letter 22282) that old paraffin burners are as good as new ones.

Put them in strong soda-water, or dip them in aquafortis. The small perforations are stopped with dirt. If the wick does not wind up, wrap a piece of emery cloth round a narrow piece of hoop iron and clean the wick tube, and always well air the wicks just previous to putting them into use.

C. B.

[22318.]—'Os's" oilman is in error. I possess one of Hincks's "Duplex," have had it burning nearly every night for twelve years, and there is nothing the matter with it yet. It *is* the wick which is in fault. In time the wick becomes clogged, in the manner of a filtering *paper*, and the oil cannot ascend in a proper manner. *There*fore, place clean wick, that which fills the burner to the $\frac{1}{16}$th of an inch; the oil will swell the wick to the full size of burner. Also clean the carbon deposit from inside the top of burner with a penknife. All will go right then, and the thin violet flame will disappear. **Cymru.**

TRICYCLES.

[22319.]—In your issue of the 13th, I read a letter from "Rug" (letter 22251) asking for information about certain points with regard to tricycles. In 1882, I had the use of a first-class machine, cranks-and-chain class, and, like "Rug," got on very well on the level, but found it very hard, slogging work when I came to any rise in the road. Early last year, after many inquiries and trials, I decided on the Omnicycle; and now, after 12 months' use and running over more than a thousand miles, I have formed a very decided opinion on the subject. I believe the principles on which it is built are in the right direction. Its chief points of merit are: No dead points; very easily altered from speed to power for hill-climbing; the feet remaining on the treadles at rest while running down hill. I think there are other machines built on this principle, though I have not seen anything like the Omnicycle. "Rug" would never find himself under the necessity to dismount, or turn the wheels with his hands, to get over a dead point on a machine of this class; for whether you make a long stroke or a short one, the machine must go on, and when one foot has finished a stroke it is taken up on the instant by the other. This is effected by a ratchet and click arrangement on the main shaft. Some have objected to this machine, because it will not go backwards when in gear, but I find it a positive advantage, for when going up-hill I can stop to look about me without using the brake. And some object to its seeming complicated mechanism that it would soon show signs of wear; but after 12 months' almost constant use it appears to me as perfect as when I first had it.

"Rug" seems to think that a coiled spring might assist in climbing hills. I think a coiled spring of sufficient strength to be of any use would add very materially to the weight of the machine, and it would be a constant weight. In your issue of

December 14th (22133), J. A. Ollard inquires what speed can be got out of the Omnicycle. In August last year, returning home after a 20 miles' spin, I came on a nice level bit of road, and with the wind on my back I thought I would try the *measured mile*, and took accurate time by my watch. I did the mile in 4 minutes 30 seconds. Another time, under same condition, but another road, five minutes, but had to stop half-way because of two carts in the way. A third time, a stiff breeze behind me, four minutes. I don't mean to say that I could do 15 miles in an hour, for I do not think it wise for anyone past middle age to run such a distance against time. I dare say a younger man might get more speed out of it; but I think eight miles an hour is quite fast enough for ordinary travelling.

Nedof.

ELECTRO-MAGNETS.

[22320.]—It seems to me that "X. N. X." (letter 22306) has made the mistake. He should have tried the experiment with the keeper on, and again with it off, not hung his weight on the keeper.

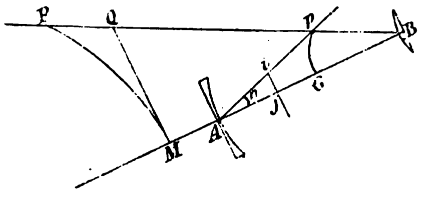
T. B.

THEORY OF THE EYEPIECE.—IV.—DISTORTION OF CURVATURE.

[22321.]—Hitherto we have only been concerned with the aberrations of a particular ray of light falling eccentrically upon one or more lenses. Now, however, we enter upon quite a different part of the subject—namely, the *form of the image* And here, it may be observed, we are concerned with three images, which we may call the first, the second, and the final. The first being that which is formed by the o.g., the second that which results from the refraction of the rays by the field lens, and the final that which results from the refraction by both lenses together.

This last differs from the first image, not only in magnitude, but also very considerably in form; and, in fact, as I shall try to show, the difference of form, &c., thus arising seems to be by far the most important element in the theory of the eyepiece, although it appears to have received much less attention than the aberrations; a fact which, perhaps, may be explained by the circumstance that in the case of an o.g. the difference in form between the image and the object is of no importance whatever compared with the aberrations, and is, moreover, irremediable; whereas in an eyepiece, on the other hand, it appears to admit of correction to quite as great an extent as the aberrations do.

We may now define the distortion to be "the distance between any point of the final image from the place which it would occupy if this latter image were similar to the original one." Thus, suppose that the first image were a straight line, and the latter a curve, MP, as in the figure, the distortion of the point P will be represented by QP; or since QBM is always small, it may be represented approximately by BQ÷BM. This is a quantity which can be easily found, and may be called approximately the distortion, remembering always that, if necessary, a correction may be applied for greater exactness.



Let us first find the distortion of a single lens placed at A. Let I i be the original image, G r the second image. A I = b, A G = c, I A i = θ. Then by the definition given above, the approximate distortion will be Ap − c. Now, by formulæ for lenses,

$$\frac{1}{\mathrm{A}p} - \frac{1}{\mathrm{A}i} = \frac{1}{f} = \frac{1}{c} - \frac{1}{v}$$

or—

$$\frac{1}{c} - \frac{1}{\mathrm{A}p} = \frac{1}{b} - \frac{1}{\mathrm{A}c} = \frac{1}{b}\,(1 - \cos.\,\theta)$$

$$\therefore \text{ distortion } = \mathrm{A}p - c$$

$$= \frac{c^2}{b}\,(1 - \cos.\,\theta) \text{ nearly } \ldots. \quad (a)$$

or if h be the height of the image from axis,

$$1 - \cos.\,\theta = \tfrac{1}{2}\,\frac{h^2}{b^2} \text{ nearly,}$$

or distn. $= \frac{1}{2}\,\frac{c^2 h^2}{b^3}$ or when the lens is used as an eyepiece, c becomes nearly the distance of distinct vision, and b becomes f nearly,

$$\text{or distn.} = \tfrac{1}{2}\,\frac{c^2 h^2}{f^3} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (b)$$

We may now find the distortion of a pair. Let a second lens be placed at B. Through p, the extremity of the second image, draw the secondary axis BpQP. Let P be the conjugate focus of p, and M that of G. Then,

$$\frac{1}{\mathrm{BP}} - \frac{1}{\mathrm{B}p} = \frac{1}{f_2} = \frac{1}{\mathrm{BM}} - \frac{1}{\mathrm{BG}}$$

$$\therefore \frac{1}{\mathrm{BM}} - \frac{1}{\mathrm{BP}} = \frac{1}{\mathrm{BG}} - \frac{1}{\mathrm{B}r}$$

Or, distortion = BP − BM = $\frac{\mathrm{BM}^2}{\mathrm{BG}^2}(\mathrm{B}p - \mathrm{BG})$ nearly. Now by trigonometry, if AB = d, and θ be small Bp = $d - \mathrm{A}p + \frac{d\,.\,\mathrm{A}p}{d - \mathrm{A}p}\,(1 - \cos.\,\theta)$ and BG = $d - c$, or

$$\text{distn.} = \frac{\mathrm{BM}^2}{\mathrm{BG}^2}\left(c - \mathrm{A}p + \frac{dc}{d - c}\,\overline{1 - \cos.\,\theta}\right) \text{ nearly}$$

$$= -\,\frac{\mathrm{BM}^2}{\mathrm{BG}^4}\left(\frac{c^2}{b} - \frac{dc}{d - c}\right)(1 - \cos.\,\theta)$$

by what has gone before.

Now $\frac{c}{b} = 1 - \frac{c}{f_1}$, therefore the above is easily reduced to distn. $= \frac{\mathrm{BM}^2\,c^2}{f_1\,\mathrm{BG}^3}(f_1 + d - c)\,(1 - \cos.\,\theta)$.

This will be the distortion for any pair of lenses; but for an eyepiece it takes rather a simpler form, for BG or $d - c$ becomes f_2, and BM the distance of distinct vision nearly = v suppose, and it becomes

$$\text{distortion} = \frac{b^2\,(d - f_2)^2}{f_1 \quad f_2^3}\,(f_1 + f_2)\,(1 - \cos.\,\theta)$$

$$= \tfrac{1}{2}\,v^2\ h^2\,\frac{(d - f_2)^2}{b^2}\,\frac{f_1 + f_2}{f_1\ f_2^3} \text{ as above,}$$

$$\text{or since } b = \frac{f\,(d - f_2)}{f_1 + f_2 - d} \text{ we have finally}$$

$$\text{Distortion} = \tfrac{1}{2}\,\frac{v^2\,h^2}{f_1^3\ f_2^3}\,(f_1 + f_2 - d)^2\,(f_1 + f_2) \ldots \text{A.}$$

This is the value here proposed for the distortion of a point in the image whose distance from the axis is h; and we see first that it varies as the square of h; next, that it is the same in whatever order the lenses are placed; and thirdly, that when f_1 and f_2 are both positive, the separation of the lenses diminishes the distortion.

It will now better be seen what a great nuisance distortion is, for not only is the form of the final image very different, in consequence of it, from that of the original; but also if the right side of (A) is very considerable, as it generally is, the points in the final image will be at such different distances from the eye that they cannot all be in good focus for distinct vision at the same time; hence there will arise *indistinctness*; and lastly, as the blue and red rays are unequally distorted, and considerably so, owing to the high powers of f_1, &c., and the distortion varying as h^2, the colouring will increase rapidly as we approach the edge of the field; and, indeed, it may not be too much to say that it is owing to this cause that colouring is visible at all. Thus, when we use a single lens, which, of course, is not achromatic, we do not perceive colouring near the centre of the field, though, of course, it must exist, but not in sufficient quantity to make a distinct impression of colour upon the eye, yet enough to impair the definition.

In the case of an o.g., however, the difference of colouring between the central and peripheral portions of the field is very much less striking, and perhaps would be quite imperceptible but for the colouring introduced by the e.p.

To return now to our equation, and put it into a form adapted to comparison with the distortion of the equivalent single lens: The distortion of the latter we have seen to be $\mathrm{D}^1 = \frac{1}{2}\,\frac{v^2\,h^2}{\mathrm{F}^3}$ v being the same in both, since it must be in each case the distance of distinct vision nearly; also $\frac{1}{\mathrm{P}^3} = \left(\frac{f_1 + f_2 - d}{f_1 f_2}\right)^3$ by means of which we easily obtain the very simple form

$$\frac{\mathrm{D}}{\mathrm{D}^1} = \frac{f_1 + f_2}{f_1 + f_2 - d} \ \ldots\ldots\ldots\ldots\ldots\ldots \ (\mathrm{B})$$

In a Ramsden this ratio becomes 3 : 2, and in a Huyghenian 2 : 1; whence the distortion of the first is to that of the other as 3 : 4. And this explains why it is that it gives a flatter field.

From this, as well as from results given in previous papers, it would seem that all the three objectionable quantities—dispersion, distortion, and sp. ab. are much greater in a Huyghenian than in the equivalent single lens, the two first being twice as great; so that a Huyghenian would seem to be a most sorry substitute for a single lens, if we made $2d$ strictly $= f_1 + f_2$.

The answer which will very likely be given by some, is simply this: "Pooh-pooh—absurd; if you will unscrew the field lens and use the other only, you will find the field is very much worse, especially towards the edges, and the colouring much greater, as it ought to be, when we substitute a single lens for an achromatic pair."

To this I would rejoin, that the objector is using quite a different standard of comparison. It is one thing to compare it with the *equivalent* lens, and another with the eye-lens. We have already compared it with the former; let us now with the latter. In form. (A) put $f_1 = 3f_2$ and $d = 2f_2$, it becomes $\mathrm{D} = \frac{1}{2}\,\frac{v^2 f^2}{f_2^3}\,\frac{16}{27}$; but distortion of eye-lens alone $= \frac{1}{2}\,\frac{v^2\,h^2}{f_2^3}$, the ratio of which is 16 : 27, and the increase of distortion producing an increase of colouring, the explanation is evident why the field produced by one lens alone is much worse than by the pair.

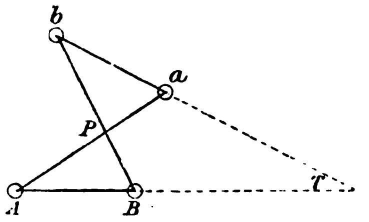
That the difference in colouring is due to the effect which the distortion has upon it, and not to the eyepiece being achromatic, is evident, as follows: when we give a further separation to the lenses, we diminish the colouring, as Mr. Bradbury somewhere says; but we also by so doing should destroy the "achromatism"—at least, if what is popularly thought about it were true, so that, by destroying the achromatism of the eyepiece we should diminish the visible colouring. But we have seen above the increase of distance diminishes the distortion, and, therefore, all such colouring as arises from coloured rays being unequally distorted.

W. G. Penny.

LINKAGES.

[22322.]—Readers of Mr. Marshall's paper on "Linkages" (letter 22283) will probably be interested in the following properties of his "contra-parallelogram"—properties so simple, and I should think capable of being so useful to the draughtsman, that they ought to find a place in elementary works on conics:—

A B b a (see accompanying figure) is a frame of



four links, jointed at A B b a. AB = ab, and Aa = Bb. P is the intersection of Aa, Bb; T the intersection of AB and b a, both produced.

Then, if AB be fixed on the paper, and the rest of the frame moved round it in the plane of the paper, P will describe an ellipse, of which A and B are the foci, Aa the length of the axis major, and Tp joined will be a tangent to the curve at P.

Again, if Aa be fixed, and the rest of the frame moved round it, T will lie on a hyperbola, whose foci are A and a, length of axis AB, PT a tangent to the curve at T; and the asymptotes will be parallel to AB, and b a in the two positions in which these lines are parallel to each other.

E. J. Lawrence.

BEE-KEEPING.

[22323.]—I think it not unlikely that many readers of the "E. M." either are already bee-keepers, or intend to become so next season; to those it would be a great matter if now someone who had a *good practical knowledge* of the best method of working improved bar-frame hives with sectional supers, would give plain directions for commencing operations on the approach of spring. I will suggest a few points on which I think some practical information would be very desirable. How soon would it be desirable to examine stocks to see how they were off for food, supposing them to have been packed for winter in November last with a fair supply of sealed stores, and to give them candy if they required it? How soon would it be advisable to commence stimulative feeding to promote early breeding, so as to have the stocks strong early, to take full advantage of the first supply of honey? What would be the *best* time for getting stocks which have wintered in skeps into bar-frame hives? and what the *earliest* time at which it could safely be done, and the best method of doing it? Also, supposing a person to have successfully introduced an imported Ligurian Queen into one stock last autumn, how to proceed to rear young Ligurian queens as early as possible, to introduce into his other stocks and early swarms, and in general how to proceed in order to get all his stock Ligurianised as early and safely as possible, and with the minimum risk of having them crossed with the black breed? Theoretical cut-and-dry information copied from bee books or Abbott's leaflets (which, however, are most useful in their way) is not what I ask for, as that can be easily obtained without taking up the valuable space of the "E. M.," but the result of the real practical experience of those who, having years, 69·2°. Mean rainfall for Beds, bedding, carpets, linen, any useful articles that can be packed (but not too bulky), it take. If the doctor is willing to some progressive township (not through woods and over rough tented to grow in prosperity with he may go with the assurance energetic) that he will succeed. classed as follows:—Pine lands, covered with hard woods), and these, again, are divided into first, quality—of pine, high and low lands, inland prairie, savannas the everglades. The area of the 8,000,000 acres, 30,000,000 of which timber; about three-fourths of of pitch and yellow pine, the with live oak, oak, gum, hickory, cedar, etc. The savannas are grass, with here and there a cabbage everglades are vast prairies, more or merged. The emigrant should choose pine land, for the following reasons, water, freedom from insects, rich soil and fruit, and ease of cultivation. products are maize (corn), sugar-cane, the citrus family (this includes the lime, grape fruit, shaddock, and rye, oats, tobacco, banana, pine- olives, grapes, and various other kinds of vegetables, lumber, and honey. pine lands from 5s. per acre; swamp to 4s. per acre. Terms of sale in all There are about 14,000,000 acres of land located in all sections of the to entry by purchase, or under the law. The cost for entering a homestead acres, £2 18s. 4d.; for 80 acres, £1 9s. acres, 25s.; residence of five years neces- rates of passage from Liverpool or Lon- should apply to Charles C. Murray and Finsbury-pavement, London, E.C. It taking up too much valuable space in the to write on other States this time; but I that Texas is the most rapidly rising the Union. Eminent Americans, who are to judge, name Texas as the best most classes of European immigrants, with and Florida about equal for second posi- Appended are a few statistics of Texas:— 175,000,000 acres; population in 1870, ; 1880, 1,600,000. Miles of railway opened years (1872 to 1882), 4,926; previous to 1872, miles, making a total of 5,974 miles. Bales raised in 1881, 1,300,000, valued at ,000. Number of live stock assessed in 1881; and mules, 952,491; cattle, 4,037,837; sheep, ,104; goats, 329,808; hogs, 1,854,229. Esti- quantity of standing pine timber, ,000,000ft., board measurement. Fruits of kinds do well; also, sugar-cane, corn, wheat other grains.—Marcos, Snodland.

2687.]—**Florida.**—Florida is considered to be of the most healthy of the States. The climate harming, and its beneficial influences are much ght after by invalids. Yearly it receives hun- ds of visitors, who are victims to some disease ther; the majority fixing their temporary resi- nce upon the St. John's River, and in its vicinity. ne Atlantic coast and St. Augustine, and the dian River country, are also favourite places for is class of visitors. The popularity of Florida for ck and convalescent persons can hardly be won- ered at, as the climate is a steady and compara- vely warm one. When it is cold it keeps so for me little time, and this feature of uniformity is also manifest in warm weather. It does not experience the sudden and dangerous changes that they are subject to in some of the other States, and more particularly in the north. These differences of temperature are most severe, even in the course of twenty-four hours. Perhaps it will be fairly warm and agreeable one day, and the next it will be piercingly cold. From this undesirable state of things Florida is pretty well free, as it enjoys a fairly even and steady temperature; and this, no doubt, accounts for the small number of deaths from consumption in that State. In the census reports of deaths from that disease for 1860 we find the following table of figures:—1 in every 254 in Massachusetts, 1 in every 473 in New York, 1 in every 1,139 in Minnesota, 1 in every 1,447 in Florida. The State is a wild, and for the most part an uncultivated one, the land being covered by pine forest, swamps, ditches, and here and there a lake or a river. Cattle roam about wild, and are only collected together about once every twelve months, that increase or decrease may be reported. They subsist on the wild grasses, and various plants and shrubs, which would be altogether unsuitable for dairy cows. The soil varies in different parts. In some places it is a kind of sand mixed up with shells, small pieces of rock, &c. In others, it is a dark mould, plentifully mixed with sand; but almost everywhere it contains a good supply of vegetable matter. However, when it has been carefully attended to, many things can be grown in it. For instance, new potatoes, melons, strawberries, blackberries, and several other things, all of which are sent to the northern markets, and realise a good profit. The sour orange, the bitter orange, and the bitter-sweet orange, together with the fig, the lemon, the lime, and the peach grow wild in Florida, and the sugar cane matures there. Many kinds of wild game, venison, and fish are very plentiful. Beef is supplied from some of the Southern States, and butter from the North. As to the quality of the former very important article of food, and especially to an Englishman, a difference of opinion exists. Some travellers say it is decidedly good, and others say it is decidedly the reverse. Then canned fruits and meat, ice, and many other such things, are imported. Altogether the living in Florida is much cheaper than in many other of the States. No doubt as the population becomes larger, and it is rapidly increasing, many improvements will be introduced. One of the sports indulged in is alligator shooting, and it is said to be capital amusement. Taking it as a whole, Florida is one of the most favourable States for emigrants to settle down in for many things. There are some inconveniences and annoyances to put up with. For instance, mosquitoes and fleas are plentiful, and exceedingly troublesome, and more especially the latter insect. But we cannot have everything just as we would wish for.—W. Henley Richmond.

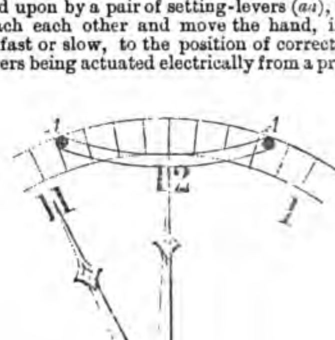
[52712.]—**Coupling Railway Waggons.**—The best mechanical tool I have yet seen is one recently patented (Graham's patent). Some are working now at Swindon and other places, giving, I believe, every satisfaction. It is made of tough metal, weighing about 8lb., and is 5ft. 4in. long. —Buffer.

[52714.]—**House Chimneys.**—I notice in my reply that there is a misprint in the last line: it should read, six times the "least" width at base.—Ditton.

[52740.]—**Drying Damp Room.**—I have had a good deal of experience in the matter of damp rooms, and I believe the only satisfactory remedy is to have the room studded inside, *i.e.*, lined with lath and plaster, leaving a space of 2in. between the plaster and the wall.—M. D.

[52751.]—**Recovering Silver.**—In answer to a "Sheffield Workman's" query, I venture to suggest a method to his consideration, though I will not guarantee its commercial, or even its experimental, practicability. Procure an electrolytic bath composed of chloride of silver, dissolved in strong ammonia. Introduce into it a cathode of silver and an anode of a bundle of the bits of silvered iron, and then pass a suitable electric current. The result will be the appearance of metallic silver at the former, and chlorine at the latter. Chlorides of silver and iron are produced, the silver compound dissolving in the surrounding ammoniacal liquid, while the iron salt is converted by it into ferrous or ferric—according to the amount of oxygen in the solution—hydrate, both of which are insoluble in the solution. A coat of this substance would tend to protect the iron from further action to a certain extent if the current is not so strong as to detach it as it forms. This action on the iron is, of course, not desirable; but, anyway, none can be deposited on the cathode till all the silver is out of the solution. I propose this method as a general plan for experiment, and if a "Sheffield Workman" should see fit to give it a trial, I should be interested to hear the result. I may add that I do not think very much net saving will result by the adoption of the method put forward by R. A. R. Bennett (page 457). From the query, it appears that the pieces of iron are ¼in. square and 1in. long, and although the thickness of the silver layer is not stated, it is not likely to be very substantial. The amount of nitric acid required to dissolve all this iron would not be inconsiderable, to say nothing of the cost of the subsequent processes he recommends. If it could be managed to use, render the iron in the so-called passive state by means of strong nitric acid, and so dissolve the silver only, while the iron remains unacted upon, the cost would be within bounds. But although I have had no practical experience with this point, I have read that it is difficult to manage. With our Editor's permission, I will briefly describe a process I started a year or two ago for the recovery of ordinary laboratory silver residues, and its advantages over the other usual methods that are recommended. The residues referred to almost always exist as chloride of silver. Wash by decantation, with plenty of water, in a capacious vessel which can be shaken, the mass—filter paper and all—till free from copper, &c. Next drain off as much water as possible, and add strong ammonia, and after a time filter to get a clear solution. Place this in a wide-mouthed bottle, which fit with a cork. Through the cork passes two wires, to one of which attach a cathode of a strip of silver, and to the other an anode of lead. Lastly, connect a Daniel cell, and leave to itself for a day or two. The strip of silver will then be found studded with crystals of the reduced metal, while the lead will have a scale of lead chloride, some of which may have fallen to the bottom of the bottle. The ammonia is then shaken up, with the remaining undissolved residue, the lead scraped, and the cell recharged, when all is again ready to proceed for another two or three days. It is obvious that a bag of the washed residues can be suspended in the electrolytic bath. It is not a process to be recommended if rapidity is an object; but this is often of no consideration whatever, as in my case. I do not, also, recommend it for large quantities, though under certain circumstances it might answer even then; but for small quantities, such as pints or quarts, I certainly do, and claim for it the following advantages:—1st and greatest. Less expenditure of superintending time and trouble than any other. The time expended in preparing the ammoniacal solution is but a few minutes. That expended in charging the cell is about the same, and besides these there is absolutely nothing to do beyond occasionally scraping the lead anode and collecting the silver crystals, after the easily fitted up and simple apparatus necessary has been procured. 2nd. Small cost of apparatus and materials. Those consumed are zinc, copper, sulphate, and lead. The ammonia will do over and over again, for the cork prevents its dissipation, and the loss in manipulation need be very small. 3rd. There is less mess and disagreeable work than any other method I know of. What little there is, is of a decidedly pleasant nature to me. 4th. The silver is obtained in a convenient form for future use, which is usually to prepare the reagent, silver nitrate. I have tried the method of reducing by means of zinc, but found these disadvantages and difficulties. 1st. It is not easy to ascertain when all the chloride is reduced. 2nd. Washing the metallic silver powder free from zinc chloride is a matter which takes a very considerable time. 3rd. The process is messy and disagreeable. 4th. The reduced metal cannot be very pure, for ordinary zinc always contains a little lead, which would remain with the silver. I have also tried reduction by means of glucose, though not very thoroughly, finding it take time and trouble. The process of reduction with carbonate of soda in a crucible is the worst of all in my estimation for small quantities. The time is greater than any others, and the heating of the crucible without special apparatus is most troublesome, to say nothing of the fuel consumed. Moreover, whatever others may find, I have always observed numerous little beads of silver scattered in a most aggravating manner all over the pot, which it is impossible to collect. I may mention that by the electrolytic method described, every trace of silver leaves the solution after a time, as may be proved by neutralising with an acid. One word more in reference to the query. It might be worth while dipping the ends of exposed iron into melted paraffin wax before placing in the electric bath.—L. S. Powell.

[52752.]—**Clocks to Strike by Electricity.**—The Standard Time and Telephone Company are the sole owners of Barraud and Lund's patents, which can be applied, at a slight expense, to any clocks now in use. Patent No. 2720: This invention relates to apparatus for synchronising clocks or other timepieces, or frequently setting them to standard time, in which one of the hands, when it reaches a certain point in its travel (say every hour) is acted upon by a pair of setting-levers (*aa*), which approach each other and move the hand, if it is either fast or slow, to the position of correct time, the levers being actuated electrically from a primary timekeeper. It consists of an apparatus in which the setting-levers are, in addition to the arms (*aa*) which clasp the clock hand, provided with cam arms, which present their opposed faces to the action of a pin, or projection, moving between them, all parts being so arranged that as the pin or projection approaches the fulcrum of the lever, the cam arms are parted, and the clasping arms (*aa*) are consequently caused to embrace the clock hand. It also consists of a weighted lever bearing the said pin, raised by the action of clockwork, and retained, when raised, by a suitable catch, and [illegible]



[illegible] accompaniment. If you want a [illegible] extended instrument, I [illegible] try to cram it into a [illegible] more room you can have [illegible] the greater will be [illegible] attaining your desired object.

[illegible] **Flames.**—[illegible] Lancaster must [illegible] alternative. If a gasburner [illegible] does not consume as [illegible] of gas consumed for [illegible] may be greater than [illegible] maximum power. [illegible] is less; but the [illegible] obtained is greater [illegible] quantity of gas consumed.

[illegible]—The resistance in [illegible] evidently too great for [illegible] sufficient quantity for it (the [illegible] the field magnets magnetised. [illegible] the distance between the [illegible] to the low tension of the [illegible] dynamo. By means of a [illegible] piece of iron wire [illegible]ing) try the effect [illegible] of the current, so as to [illegible] magnets. This will render the [illegible] in the resistance of the [illegible] more nearly proportionate to the [illegible] each ampère of current [illegible] the copper solution, [illegible] say 32gr. in two [illegible] amperes will give [illegible] about 1½oz. per day of [illegible]

[illegible] QUERIES.

[illegible] which remain unan[illegible] inserted in this list, and if still [illegible] afterwards. We trust [illegible] send what information [illegible] contributors.

[illegible]

[illegible] **Anaesthetics.**—M. Paul [illegible] communication to the French [illegible] produced by [illegible] vapour, and air. His [illegible] beings of various [illegible] to adults of both [illegible] healthy, others [illegible] debilitated. Very [illegible] performed on the [illegible] of the chloroform [illegible] amputations of limbs, [illegible] the operations has [illegible] lasting [illegible] were similar in [illegible] employed was [illegible] vapourised in 100 [illegible] were used the [illegible] thinks it una[illegible] mixture is not dis[illegible] patients rather [illegible] conditions [illegible] by the new [illegible] arrest of [illegible] always very [illegible] patients not [illegible] of the same [illegible] insensibility [illegible] the most, and [illegible] during the [illegible] The pulse [illegible] sleep, and was [illegible] period of [illegible] regular as in [illegible] when it was [illegible] the body [illegible] had no [illegible] disturbance. [illegible] These advantages, [illegible] in favour of

QUERIES.

[52925.]—**Dissolving Leather.**—Can any of our chemical friends inform me if leather could be dissolved, and then pressed into a mould?—H. S.

[52926.]—**Double-Cell Bichromate Battery.**—Would "Sigma" explain the reason of a thick yellowish-brown mud depositing, in about twenty minutes after starting this form of battery, on the zinc plate in porous [illegible] Zinc is well amalgamated, and mud forms on it. When [illegible] is rubbed off, amalgamation still [illegible] Am using dilute H_2SO_4 in inner cell, and ordinary bichromate solution as recommended by "Sigma" [illegible] with bichromate batteries in outer cell with two carbon plates, 6in. by 3in. Zinc 6in. by 3in. Have used dilute H_2SO_4 1 in 12, and half saturated solution of $ZnSO_4$; but with above result. Otherwise this seems a good form of battery, as it is more constant than single fluid bichromate.—[illegible]

[52927.]—**Watchwork.**—I have an English lever watch come to me to repair which has been to three or four men in the trade to repair, and they have failed to give satisfaction. I have been in the trade for about four years, and have not learned everything yet, and would like to do this job. When I wind the watch to the top, the action of the balance is nearly at a standstill, but when the watch has run half-way down the action is splendid, and keeps good time. A remedy would oblige.—PERPLEXED ONE.

[52928.]—**Copperplate Printing.**—Will some one give me the name of an ink, paint, or varnish that will print well from copper plates, and stand the action of aqua fortis? Also a recipe for making a transfer paper, so that patterns, when printed, may be transferred to a flat surface, and paper be removed.—H. B. H.

[52929.]—**Engine Query.**—Thanks to "Labor Omnia Vincit" for his last reply. They are a pair of non-condensing engines: 21in. diam. cylinders, 3ft. stroke, 70 revs per min., and work at a pressure of 5[illegible]lb in boiler.—ENGINEMAN.

[52930.]—**Filter Presses.**—Will some correspondent oblige me with particulars of the best form of above for separating a very bulky precipitate which it is required to wash well? It will be necessary to reserve both the precipitate and solution for subsequent use. A rough sketch, or any details, will be very useful.—FERRO.

[52931.]—**Anotta.**—I wish to make my own fluid extract of anotta to mix thoroughly with milk, butter, and cheese; but I do not know what quality of anotta is used: Is it roll, or are there any others, and what is it dissolved by? I have two samples beside me: One is a dark fluid, the other is a red fluid: but I prefer the red quality, as it mixes better and goes furthest, and produces a richer tint.—FLUID.

[52932.]—**Delirium Tremens.**—Can it be explained why persons suffering from the above malady always have the horrible depicted upon their mind's eye, and never anything pleasing? There must be a reason. Is it known?—CYMRU.

[52933.]—**Timeball.**—Having made timeball to fall by electric current (from kind instructions of Mr. Baldwin), I am at a loss how to get it in position again. Can I wind it up in any way by electricity? Will "Sigma" or Mr. Lancaster oblige?—W. JONES, 78, Viaduct-street, E.

[52934.]—**Lantern.**—Could any of our readers who have had experience with magic-lanterns give me information on the following points? Is there any lantern made that will show ordinary 3in. by 1in. microscopic slides satisfactorily? If so, can they be shown with petroleum lamp, and what sized discs will a 2in. and a ½in. objective throw on the screen, respectively? I want to give some demonstrations of microscopic objects in a country village to an audience of, say, 100 people. Any hints will oblige.—M. D.

[52935.]—**Legal.**—Would any legal friend oblige me with the reference number of the statute which makes a man liable for the maintenance of his grandchildren?—O. RUSSELL PRIDHAM.

[52936.]—**Small Siemens Dynamo.**—I am just completing a Siemens H dynamo—a 6in. by 2in., 1½lb. No. 18, F.M.'s 5lb. each No. 14 copper wire. I wish to know what is the least external resistance I may use without unduly heating the coils. Are the magnets reckoned with external or internal circuit—the machine being series wound?—A. W. LAMBERT.

[52937.]—**Ancient Lights.**—I am about to erect a building in my back garden 35ft. high, at a distance of 20ft. from the back of the house; but am afraid it may injuriously affect the light of my workroom, and also back parlour. The workroom is on the level of the garden, and the window is of an ordinary size. The light is not derived from the sides, but direct from the back. The parlour is above the workroom. Would this arrangement be likely to materially affect the lighting of those two rooms?—DENTIST.

[52938.]—**Heating of Journals.**—Can any of "ours" explain the cause of heating in journals when shaft is well bedded, true, and running without load at 400 revs. per minute? Diameter of shaft is 6in., and as soon as one neck cools another starts getting hot. I have tried all kinds of compositions, but all are useless. At 300 revs. per minute, however, the shaft runs well.—APPRENTICE.

[52939.]—**Binocular.**—When I look at the sky through a binocular bought from a maker of highest repute, a central darker area, and round it a lighter marginal ring are seen. If a radius be taken, the former occupies about two-thirds, and the latter about one-third. The defect is in the eyeglass, as is ascertained by looking through it separately, and it does not depend on reflection from the inside of the tube. Blackening the outer edge of the eyeglass has not effected any improvement. Can any reader kindly say what is the cause of this defect, and whether it is inseparable from binocular eyeglasses, or in what way it can be remedied?—I. C.

[52940.]—**Gas Stoves.**—Will Mr. Fletcher kindly say a few words in explanation of the corrosion of gas-[illegible] as [illegible] and as [illegible] remedy? [illegible] or rather eaten away, in less than six months. It was made of the [illegible] I have now replaced [illegible] copper [illegible] and the [illegible] the same way.—[illegible]

[52941.]—**C.R. Engines.**—[illegible]

[52942.]—**Converting Sewing-Machine into Fretsaw.**—[illegible] a sewing machine [illegible] make a fretsaw without [illegible] trouble and expense [illegible] well? Then how would I get the saw perfectly [illegible] a better plan?—[illegible]

[52943.]—**Electro-Magnets.**—[illegible] with the armature [illegible] both poles of the magnet [illegible] sticks to the magnet when the current is released. In an apparatus I am constructing I want the armature to be in actual contact with the electro-magnet, but want to prevent the sticking of the armature when contact is broken. Can this be done without sacrificing the holding power of the magnet? When the armature touches only one pole of the magnet it drops off only when the current is stopped, but I want to utilise all the holding power of the magnet, and yet be free from the sticking armature when the current is released.—[illegible]

[52944.]—**To Mr. Wassell.**—Will Mr. Wassell kindly advise me how to correct a mirror I have ground and polished? I have compared it under the same test with a [illegible] mirror I possess of Calver's. The appearance of mine is the same as Mr. Calver's, only more so, so I judge it to be hyperbolic. It is without rings, but in various directions across the face of the mirror I see straight lines, which I can in no way account for, and it is with regard to them that I should be grateful for Mr. Wassell's opinion.—[illegible]

[52945.]—**Oxidising Copper Wire in the Battery.**—What is the reason that the copper wire oxidises in the battery? Also, if there is any way to stop it? We use salammoniac and copper wire to connect the bottles.—"E. M." READER.

[52946.]—**Lightening a Wife's Domestic Duties.**—I should be extremely obliged if some correspondent would devise some simple and inexpensive little pump by which a lodger could raise the water necessary for his wife's domestic consumption, about two gallons daily, from the cistern of the house, which is situated about 12 or 14ft. below the window of his living room. No fixtures to cistern would be allowed.—A PERPLEXED PARTNER.

[52947.]—**Spectrum.**—Having been studying Mr. Lewis Wright's admirable book on "Light," I recently attempted to produce the spectrum by means of a bisulphide of carbon prism. As it was a private experiment, I did not take the trouble to prepare gas, but used a powerful oil light. Although I put a slit in the lantern stage [illegible] by [illegible]in., and generally followed the directions given, I could not get the band of colour. I tried with and without both condenser and object lens, and also interposed a biconvex lens of [illegible] focus between lantern and prism; but still without success. The dim band of dispersed light produced showed no colour whatever. In my perplexity I turn to the "E. M.," and beg to say that I shall be grateful to any kind friend who will point out what was wrong in my proceedings, or, better still, indicate the right method of obtaining the desired result.—W. HOBBS.

[52948.]—**Banjo.**—Could any of our readers kindly inform me 1, the best tutor for a six-stringed banjo, and the publisher of same? All the tutors I have seen treat chiefly on the five-stringed banjo, and say practically nothing about the six. 2. What sized strings should be used for a six stringed banjo? 3. In striking the notes with the thumb and forefinger of the right hand, should the tip of the forefinger be farther from or nearer to the bridge than that of the thumb?—P[illegible]

[52949.]—**Length of Cord.**—An acre of ground contained within a complete circle. Required the length of cord that will exactly sweep half an acre of the same when attached to a stake at extreme edge of circle?—J. B.

[52950.]—**To Violinists.**—Having lately begun the study of the violin, I want to ask advice from "those who know" on one or two points. I have been much annoyed by constant breaking of strings, and this I think I have traced to perspiring fingers. Is there any remedy for this, or anything which could be recommended as likely to modify the evil, if not quite to obviate it? Then I find that my hand, and especially my little finger, is so ridiculously short that I cannot by any means reach B on the first string, not to speak of D on the fourth, without shifting my hand. Is there any exercise or method of stretching the hand which would be of use? I may say that I am 25 years of age, and will be content with a very moderate proficiency; and perhaps my joints may be too stiff to enable me to get over these difficulties at all.—BEGINNER.

[52951.]—**Smiths' Forge.**—Would some practical person kindly instruct me the best way to fit up my forge for general country work, both light and heavy, as I can't get on with the one I have now? I have tried different ways, but can't find the right one. The forge burns a lot of coal, but always makes the iron so rough with scales and clinkers that I have to scrape or file it. Is it the fault in the tue-iron in fixing it? I have one at it with a ¾ hole in it. The bellows is a large one, and I use Welsh coal. Could some one kindly instruct me how to make a simple perpendicular drilling machine to drill up to ½in. holes?—YOUNG COUNTRY SMITH.

[52952.]—**Loss of Voice.**—Will some correspondent kindly advise a beneficial remedy for this distressing complaint? I have no cough, throat not sore; and I am to having got very wet in the feet for some days— month since. Have tried several remedies. and 'erent doctors have prescribed—but to no purpose. seen good results from answers for different ailin "ours," I hope to derive some benefit from ho may have suffered similar.—M. L.

3.]—**Latitude and Longitude.**—To "O. V." .ERS.—Is there any rule by ordinary arithmetic it algebra) to find the number of English miles ed, when the number of degrees is given in latiad longitude, and what difference in reckoning ıe first or second meridian is given?—CYPHER.

4.]—**Hand Water Tap.**—I require frequently w a variably continuous gentle stream of water ticles held steady by the left hand, and which canveniently be moved about. I am thus left with e hand free to control the water supply, and 'eel much obliged if any of "ours" will tell me construct a small, simple, and inexpensive hand attachment to a ⅜in. elastic tube connected to verhead cistern) by which, whilst held in the right could, say, with the thumb or any of the fingers, or off the water at pleasure. The perforation at z e need not exceed 1-16in. in diam., and there ittle or no water pressure, the hand tap does not to be of any great strength.—ARNOLD WARBUR-

5.]—**Tiles.**—What should be done to re-establish of blue quarries which have been made light by used in setting them? The cement has been over surface for filling joints.—CLAY.

6.]—**Dyeing Furs.**—I am desirous of obtaining nt information to enable me, as a dyer, to dye the ıcks and browns used in present fashion on sealnd other furs.—JAS. CHALMERS.

7.]—**Hydraulic Lifts.** — Will some reader describe the construction of those small hydraulic ıich I have seen used for getting big guns into ı?—JASON.

8.]—**Ancient Lights.**—It is desired that some ildings in the course of erection shall not encroach he legal 45° line of light of the neighbouring An argument has arisen as to how the 45° is to ıd. One says that the proper, practical, and techlan is, that if the wall to be built is 15ft. high, its ust approach the neighbour's back within 30ft.; r says that wall being 15ft. high, the approach may ear as 15ft. This seems to me to be correct; as in case 15ft. perpend. 30 base, a right-angle triangle use hypoth. to subtend from top of wall an angle , the complement being 22½°; while in the second rpend. and base 15ft. each, right-angle triangle will ypoth. to subtend from either point angles of 45° GREEK.

9.]—**Beer in Scratchbrushing.**—What can s a substitute for beer in this process? Will anynswer so well?—W. H. H.

0.]—**Plate Machine—Silk Flaps.**—How are ps attached to rubber, and what kind of oil is used hem? Should there be more than one thickness of My reason for asking is that when I used black ed with flask oil, instead of a gain, I found a loss er.—W. H. H.

1.]—**Butterflies.**—Will some kind entomological pondent help me in my difficulty? I have had a ase of butterflies sent to me from Nepaul, but the are closed and rigid. I want to open them. I have team and moist sand, both of which are tedious think, injurious to the plumage. Are there no ds rapid and safe?—LU.

52.]—**G.W.R.**—Can any reader oblige me with ılars of No. 55 Queen, single? Also Nos. 483, 490, 8, all 4-c.—T. M. R.

3.]—**Weight of Coaches.**—Can any of "ours" me with the weight of six and eight-wheel s, now in use on the principal railways?—T.

4.]—**Medical Coil.**—I made one with three f No. 22 for primary, and six rows of No. 36 for lary. I found it take a strong current to work it, t much power then. Thinking if I had less resistı primary, less battery power would work it, I unl and put two rows of No. 16 as primary. I still will not work with less than one cell of bichromate of Smee. Two cells of Fuller, or two of Daniell, t work it. They do not seem to magnetise the core ently. Core is No. 18 very soft iron wire, and when power enough to magnetise it, I get a very powerondary. Had I better go back to the No. 22, and ave two rows? All the layers are well insulated paraffin. I have made a very satisfactory primary ter Mr. Fred. Walker's pattern (but a little larger), ıis works with one cell of Fuller or one of Daniell, quires a water regulator to modify the effects. I my secondary coil to work with as little an amount tricity as the other one.—J. E. A.

65.]—**Regulator for Shocking Coil.**—Will f our readers kindly inform me how to make ılator for a shocking coil 7in. long?—No. 16 cottond wire primary, No. 36 silk-covered for secondary. ɪGO.

966.]—**Strength of Spring.**—Would any of readers inform me what strength of spring steel I I require to make, so that a man could just wind th a windlass 2ft. 6in. long—i.e., a stroke of 5ft.? what length of spring I should require to continue rce equalling the man's strength for two, four, or urs?—E. M. B.

67.]—**Hydrogen Peroxide.**—Will some of your cal contributors have the goodness to furnish me a few particulars upon the preparation and proper- hydrogen peroxide? The subject is referred to in rrent issue of the *Jour.* of the Chem. Soc., p. 226, o briefly to be of much assistance. The points on I seek information are—(1) A practicable mode of mically preparing hydrogen peroxide? If not cont in a small laboratory, say if the barium xide can be procured ready made, and how the gen peroxide is prepared from it? (2) Ch. of lime is understood to be soluble in 10 parts of water, a given measure of which furnishes a measurable quantity of available chlorine as bleaching or oxidising agent. Now state in what proportion the soluble hydrogen peroxide is soluble in water, and the oxidising power in comparison with an equal quantity of the 10 per cent., or saturated, ch. of lime solution, and also with a solution of potassium permanganate of known strength? (3) Supposing that the hydrogen peroxide proves to be feebly soluble in water, is there any other menstruum in which it can be stored up in a concentrated and available form? (4) Are there any known means of economically preparing ozone for employment as an oxidiser in concentrated solution?—AMATEUR.

[52968.]—**Slide-Valves.**—To "ENGINEER," OR "FIRER, Dewsbury."—I have several books on the steam engine, but I cannot find in any of them the formula for the proportions of lap and lead for slide-valves, such as are necessary for answering questions set by the Science and Art Department. As an example of such, "The lap on the steam side of a slide valve is 1⅛in., that on the exhaust side is ¼in., and the lead is ⅛in. Find the opening for exhaust which the valve will give at the lower part when the piston is at the top of its stroke." I would like it wrought out in arithmetic, also the formula with it.—FORMULA.

[52969.]—**Chloride Battery.**—What is the best form of charging this battery (for bell work only)? If I had two sets of porous pots, one set being kept soaking, whilst the other was in use, would they become sufficiently clean in the pores, or nearly as good as new?—R. HANNEN.

[52970.]—**Cup Leathers for Garden Engines, small Plunger Pumps, &c.**—Will any reader kindly tell me the best way of making these? I have a lathe.—AQUARIUS.

[52971.]—**Antimonial Lead.**—Will any one of our chemical readers give me an easy method of ascertaining the quantity of antimony in an alloy of that metal with lead containing, say, from 5 to 20 per cent. of antimony? My knowledge of chemistry being very limited, I should require plain instructions. I fancy a method by volumetric tests would be very convenient.—GALENA.

[52972.]—**Turning Stone.**—Having a turning lathe' power, and wishing to turn a few small circular sandstone pillars, would "J. H.," or any of "ours," kindly inform me if I would require to put iron centres in them, and if the tools used for turning iron would do? Also if the tools require oil or water during the process, and some information as to putting the best polish on the pillars when turned?—GEORDY BLACK.

[52973.]—**Sharpening Circular Cutters.**—In a science textbook that I have ("The Strength of Materials," by John Anderson) the following words occur:—"It is not many years since it was deemed impracticable to sharpen hard steel circular cutters without first softening them; yet we now see that it can be done as easily as sharpening a drill at the grindstone, and by an arrangement as old as the cutting of diamonds, and upon the same principle." I should like to ask some of your numerous correspondents to kindly explain the arrangement alluded to, and oblige?—A. SUGDEN, Leeds.

[52974.]—**Pyro-Hydrogen Light.**—In Mr. Chadwick's "Lantern Manual" mention is made of the pyro-hydrogen limelight. Will Mr. Chadwick, or Mr. Lancaster, please tell me if this light is a success? The light is produced by a stream of hot air and hydrogen impinging on a piece of lime, which it heats to incandescence. Also tell me if common house gas could be used instead of hydrogen. If I am not asking too much, I should be glad to have a drawing of the most approved form for lantern purposes, I shall be glad to see query 52897 fully answered. It would be an easy matter for any reader who has the slides named to explain their motion, &c.—GRAPHO.

[52975.]—**Oven for Malleable Castings.**—Will any reader give me a sketch and description of the ovens used in foundries where malleable iron is made for keeping the articles hot for three or four days together? I have tried to get books giving sketches of these ovens, but failed. A sketch is necessary.—J. H. B.

[52976.]—**Bleaching Horsehair.** — I want to deprive black horsehair of its colouring matter, and produce a white or yellow, without destroying its elasticity or burning it. I have tried hydric peroxide and chloride of lime, without success. Is heat necessary? Replies in back numbers have all been tried. The advice of our chemical friends will much oblige.—D. GAMMIE.

[52977.]—**Hydraulics.**—(1) What would you consider to be the right sort of test to discover the cause of the failure of a rising main? (2) What reason could you give why a pipe (any size over 2in.) will not run full bore with any head over 6in.?—J. DURHAM.

[52978.]—**Dynamo.** — Would "Sigma," or some other correspondent, kindly tell me if a Siemens compound armature has any advantage over the simple H form for incandescence lamps, and if so, I should be greatly obliged for working description of mode of winding a compound armature, with proportions of wire for small machine with magnet 10½in. high, length of pole-pieces 5½in., core on which to wind wire 5½ by 4 by ⅞in., width between centres of cores 3in., armature 5½ by 2¼in. Also what would be the best way to wind magnet, series, shunt, or compound, for incandescent lamps?—J. P. M.

[52979.]—**Railway Keys.** — I shall be glad to know the opinion of your engineering correspondents upon the position of railway keys. The Midland Coy. have, for years, placed the keys inside the rails. Last week a great change was made, and for the future the keys are to be placed outside. Can any reader tell me the actual cause of this important alteration?—as doubtless a company would not go to this great expense without some reason.—HISTORIAN, M.I.M.E.

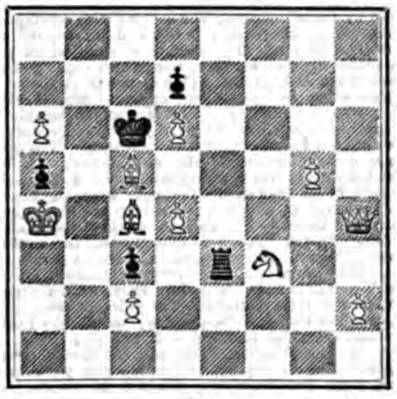
[52980.]—**Crescent Moon.**—A friend of mine saw the moon with the naked eye shortly after six on the evening of the 29th ult., when our satellite was not 38 hours "old." Would any reader say whether this is noteworthy in our wretched climate, and also state the "youngest" moon that has been seen with the naked eye?—ARTHUR MEE.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXXIII.—By SERGT.-MAJOR McARTHUR.

Black.



White. [11+5

White to play and mate in two moves.

SOLUTION TO 871.

White.	*Black.*
1. P to Q 6	1. Anything
2. Anything	2. Q mates

(4 variations.)

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 870 by J. B. of Boxford, F. Renney, Dicky Sam, and T. H. Billington; to 871 by Rev. W. Anderson (Old Romney), W. H. Evans, A. Schmucke, J. G. E (Sittingbourne), J. B. of Boxford, E. S. Follwell (Bristol) (weak; no scope for Black), Dicky Sam, T. H. Billington, F. Renney, and D. Millar; to 869 by A. Schmucke (second solution); to 868 by F. Renney.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 6, and unacknowledged elsewhere:—

J. P. STRANGMAN.—Crossley Bros.—J. Mackay.—J. Hargreaves.—C. Nickalls.—G. W. Healey.—E. W. Spofford.—P. A. Ransom.—T. Massa.—H. Lovegrove.—W. A. Smith.—J. B. Yonge.—C. E. Fison.—F. H. Smith.—M. Taylor.—E. M. Nelson.—M. A.—One in the Trade.—Eothen.—Organic Chemist.—H. C. B.—Corrigenda.—H. B. T. Strangways.—F. W. Brewer.—W. G. Penny.—T. R. Clapham.—Fred. Carre.—C. E. B.—C. Detaille.—D'Elgo.—R. T. Lewis.—A Fellow of the Royal Astronomical Society.—S. Bottone.—M. Y. C.—C. E. Stretton.

AN HUMBLE READER. (So far as we understand your query, we should answer it by the question, Why should it be?)—A YOUNG LITHO. (Many recipes in back numbers—actually one on p. 457. The liquid in the streets is solution of nitrate of mercury, which will spoil anything to which it is applied.)—TELEPHONIC. (The "rule" is a calculation of the total resistance and the quantity of current required compared with the known E.M.F. of any given cell. Do not understand about the commutator. Surely it has that already.)—P. E. GATES. (Yes to both questions; but if as a motor, how will you drive it?)—QUILLDRIVER. (Can only be done by careful measurement and frequent trial as work proceeds.)—CRACK IN BOILER. (Frequently answered. The proper cement is that made of iron filings, sulphur, and sal-ammoniac; but it requires some skill to use it in such a situation, and it would be cheaper to have a new boiler.)—ENQUIRER. (Doubtful if there are several works on the subject; but try the list issued by Mr. Hastings, 22, Buckingham-street, Adelphi, W.C.)—BROTHER STIGGINS. (As no one has made such a machine, how is it possible to say what it will do? We have no space for "notions" of that kind. If you want a dynamo, make one to the pattern given in these pages.—W. P. W.: Waves of Kiev. (You will find illustrations in Vol. XXX. p. [illegible], Vol. XXXI. p. 3[illegible]1, Vol. XXXV. p. 5[illegible], Vol. XXXVI. p. [illegible]03, all with illustrations.)—Scott & Hart. (Mix whiting with the [illegible], but if a very high temperature is reached, whiting and boiled linseed oil (putty) make a good lute. [illegible] and [illegible] low will stand almost anything.)—[illegible]. (You cannot adopt another man's crest, but you will have to apply to the Heralds' College, Queen Victoria-street, E.C.)—Shad. (It gets in by means of a valve—the snifting valve.)—[illegible] N.E. (It should be examined by a medical man, but bathing with solution of permanganate of potash, Condy's fluid, will do no harm.)—A Novice. (Try acetate of iron, which you can make by steeping iron filings in vinegar.)—[illegible] Olson, Clear Lake, Iowa. (We do not think that it is still on sale; but you could apply to Mr. Wesley, Essex street, Strand, London. He might be able to procure you a copy. 2. Why not send here for one, as many of your fellow-countrymen have done. The duty is not quite prohibitive.)—E. J. [illegible]. (1. We cannot say what the company would do. 2. A speaking tube would answer, if there were not many bends. 3. That could be easiest answered by the surveyor to your local board.)—[illegible]. (A work of the kind is advertised in the "Sale" column the last two weeks.)—James T. Webb. (See the indices of back volumes.)—J. B. (They are not. Saunier's "Watchmaker's Handbook," published by Tripplin, Bartlett's-buildings, E.C., is the most suitable. The price is, we think, 12s. 6d. For books on "Carpentry," see Crosby Lockwood and Co.'s list, and that of E. and F. N. Spon.)—J. A. Ryde. (Thanks. You will see that a correspondent has already replied fully, and we cannot afford more space for a subject which is, after all, of little interest to the majority of our readers.)—N. B. (It is, as its name implies, mashed paper. The majority of articles are made of the pulp before it is converted into paper. You can easily try by stewing some old paper until it can be pressed into a solid block.)—Nimrod. (The bottle query is an advertisement, pure and simple.)—Ajax. (You will find several recipes of the kind by searching the indices.)—G. M. [illegible]. (You may go on scraping until doomsday, and you will never get *two* blocks to a true plane. Scraping is right; but you must have *three* blocks to check one another. See the Whitworth Papers, in Vol. I. of which you will find the art of making true planes fully described. Every mechanic ought to have those Papers.)—X. Y. Z. (No, a siphon will not answer where the height to be lifted is greater than, say, 30ft. It depends on the weight of the atmosphere and the height of a column of water which it can support.)—C. E[illegible]. (No doubt some one will offer to repair it, if you advertise your address.)—H. E. J. (He described his magnesium lamp on p. 277, Vol. XXXVI.)—Battery. (Draw the magnet several times over it while the current is passing, but always in one direction. It is better to use a coil of wire.)—Advertiser. (The query has been frequently answered. For all the use they are, methylated spirit would do as well.)—Southport. (They are out of print now; but you would find much information by looking through the back volumes.)—[illegible] W. (They will do, but are nothing like so good as the proper lenses. You should read the papers on "How to Make a Magic Lantern" in the back volumes. See recent replies about the developer.)—[illegible] B. [illegible] (Plenty of devices of the kind in back volumes. The very thing that you think will suit you was illustrated on p. 524, No. 990.)—James Eastwood. (We are unable to find the points of novelty in your description, because you do not give them. We should [illegible] a shaft, with a wheel of that weight on, to run as [illegible] as you say.)—Devonshire Reader. (Will [illegible] a trial, and make a note of it.)—F. J. [illegible]. (We really do not know: it would make [illegible]. The bob would have to be pushed up at [illegible] a seconds pendulum at St. Thomas (very [illegible] the Equator) to [illegible]in., and at Hammerfest [illegible]. It helped to prove the lesser attraction. You should read the subject in any good text-book. [illegible] is called centrifugal force comes into [illegible] very different at the Equator to what it [illegible].)—S. J. F. (See p. 1[illegible]6, Vol. XXXIII. [illegible] over a piece of whalebone with [illegible] and use warm water and soap, rinsing [illegible] to clean the mercury, pour over it a solution [illegible] acid and water, about 1 to 5, stir, and [illegible] then squeeze the mercury [illegible] filter, or if it looks clean [illegible] two or three times.)—[illegible] the bronchitis is concerned, you [illegible] conditions there, and the voyage [illegible]. We cannot advise as to emigra[illegible] communicate with the agents-general [illegible], 3, Westminster-chambers, [illegible] difficulty about the money. [illegible] with any London banker, who will [illegible] on a bank where you go.)—[illegible] pure is used only for chemical [illegible]. (You can procure [illegible] warehouse, and will find a [illegible] in Vol. XXX. pp. 4[illegible], 4[illegible], [illegible] numbers.)—J. H., Burnley. [illegible] in No. [illegible], and some[illegible] volume, but as a matter [illegible] requires a deal of practice.) [illegible] turning, and a good deal [illegible]. There is a diagram of a [illegible].)—Markham. (Con[illegible] Lyell's "Principles [illegible] Vol. XXIX.)—Jennings. [illegible] will cure it, but [illegible] depends on circumstances.) [illegible] No [illegible], for method of [illegible] frequently answered. 2. [illegible] equations, but must have [illegible] to which it [illegible] that all sorts of hints [illegible] the best arrangement [illegible] the surrounding mould [illegible] be as effective as if [illegible], Glasgow. (We [illegible] require advice, and [illegible] competent to give [illegible] manipulation. You should, in the circumstances, write to the aurist, and tell him what has happened.)—Blowpipe. (Thanks. We are afraid it would not be appreciated.)—Amateur. (Do you not understand that it would be necessary to make one of that size and experiment with it before your question could be answered. You can obtain a good deal of information from back numbers.)—Binder. (Try again. How can they become straight if you glue up and allow them to dry?)—John Hale. (The makers might be able to answer the question; but no one else can on data so meagre.)—W. Jones. (Battery-cells are not comparable in that manner; it depends on what they have to do. Daniell's, Fuller's, Leclanché's, and some others.)—D. and W. (You will find a description of the Ross battery on p. 260, last volume; or, if that is not sufficient, a full account can be seen at the Patent Office Library.)—Naphtha. (You must explain more definitely what you mean; if miner's safety-lamps, gas must be used.)—Mechanic. (The method of magnetising steel has been frequently given. You can use either permanent magnets, or a coil of wire through which a current is passing. Bessemer steel would be better than that mentioned.)—T. A. C. (Directions for making electro-magnets have been frequently given, also electro-magnetic engines. See the indices.)—J. B. Jack. (If you cannot make either a Wimshurst or a Voss machine from the instructions given recently, we do not see how anyone can help you, except by making it for you. We cannot spare the space to give working drawings of every detail.)—G. H. S. (Glue one part, glycerine four parts, whiting quantum suff. Some use more glue. A little carbolic acid is a preservative addition.)—Phos. (The query was due for insertion in the unanswered list week; but you will see by p. 475 a correspondent has partly answered it, and called direct attention to it. Consequently, it will not be worth while to insert amongst the unanswered. If no notice is taken now, it will be better to insert another query.)—W. B. (We are as wise as ever. A jet of steam turned into a smith's fire would put it out. If you have seen it done, surely you can give more particulars, and say definitely what it is you want to do. We cannot pretend to remember all the queries we receive.)—Edward C. Corin. (Having passed an examination in chemistry, we believe; but why not write to the secretary.)—Donald M. Warren. (There is a polariscope on p. 175, Vol. XXVI., and some articles on it in Vol. XXXI. pp. 538, 561. Also many other places in back volumes. 2. Yes; several.)—W. J. Rendell. (The subject has often been discussed. See indices to back volumes, or p. 421, Vol. XXXII.)—G. Downs. (On the contrary, we think there is a good deal about it, though perhaps not a series of articles. We are bound to cater for the greatest number, and a special subject like that interests but a few, and those few are already provided for in a book issued by Crosby Lockwood and Co. As a rule, we prefer subjects that cannot be found in cheap text-books.)—Longworth. (Yes, that would do; but as you are sure to desire a bigger by-and-by, you might buy it at once. We cannot undertake to advise between a refractor and a reflector. Cannot you manage to have a trial of both, and see which you like best? As to the atmosphere, plenty of good work can be done in London. You would gain much information from a perusal of back numbers.)—Auntie. ("Small doses" is all that was mentioned. The druggist will tell you the proper quantity. It was given on p. 512, last volume.)—Pen. (It is logwood stain, made by boiling a pound of logwood for about an hour in three quarts of water. Then add an ounce of salt of tartar. Give two or three coats hot, and put in the graining marks with a brush and a strong solution of green copperas.)—G. R. Carmac. (You might get them off with a disc of copper, the edge of which is anointed with fine emery and oil; the disc to be run at a high speed in the lathe.)—A. S. Edmunds. (Yes, so it is said; but very little is known of it.)—McArthur. (The curtain might answer, and so might wires; but nothing definite could be said without at least having some idea of the size of the hall.)—J. H. (We should think not. A dynamo must have an engine that is always its master.)—Cinder Hill. (You are too late. The designs were all in some weeks ago. 2. We do not understand the difficulty.)—J. Durham. (The *Miller* is published weekly by W. Dunham, 69, Mark-lane.)—M. Rellum. (They put a little wax in the starch, and use a polishing iron.)—Student. (See the articles now appearing and back numbers. It is impossible to insert all the queries about dynamos, or the replies that might be received in answer.)—Moulder. (See previous answer.)—Investigatrix. (How can we say without seeing the examination paper? 2. The easiest way is to take lessons. Apply to the music dealers for instruction-books. 3. Advertise them. Dealers have to keep them a long time, so they cannot afford to give much.)—E. E. P. (See pp. 25 and 376, present volume. If the invention is perfected, it is better to send in complete specifications at once.)—Harry Ambrose. (Nearly every grammar contains sufficient. There are very few rules. 2. It depends entirely on the size.)—Dough. (Any oven-builder will give you the required information. You do not say what size you need; but as a guide, you can reckon that a good eight-bushel oven will cost about £30.)—Cypher. (Nothing very novel in your device; but it does not follow, because it suits you, that it would answer in all circumstances.)—A Cornishman. (In any case, it is only a matter for a civil court; X. cannot be "punished," but you may sue him and recover if your story holds good.)—R. D. (The father must administer; he had better employ a solicitor, though it is not absolutely necessary.)—Legal Puzzle. (Exactly. Who *is* the next of kin? That is the point which stands in the way of a good many other divisions of property similarly left. We cannot tell you.)

Boswell. (Duplications of letters sent to other journals are not desired.)—H. A. C. (Perry and Co., Holborn Viaduct; we believe they send samples of the material post free for one shilling.)—A Pit Lad. (His occupation, of course, varies. You had better get into an office and work hard, and then select the branch you like best. As to books, send to Lockwood and Co., 7, Stationers' Hall-court, for a catalogue, stating what you want.)—[illegible]. (Of course, the judge was right. People who trust anybody cannot expect the protection of the criminal law.)—A Poor Inventor. (There is only one way, the one you mention, and a patent is cheap now, but previous attempts in the same direction are numerous, and you would do well to search carefully at the Patent Office to see that you have not been anticipated.)—Iolanthe. (We know no such address.)

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About 50 Magic-lantern **3¼ Slide Views**, &c., would exchange for good condenser.—Address, [illegible], Renfrew-street, Glasgow.

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Tool Chest, equal to new; offers in small lathe, pair of headstocks for small do., and flywheel.—E. Floods, C[illegible], Wilts.

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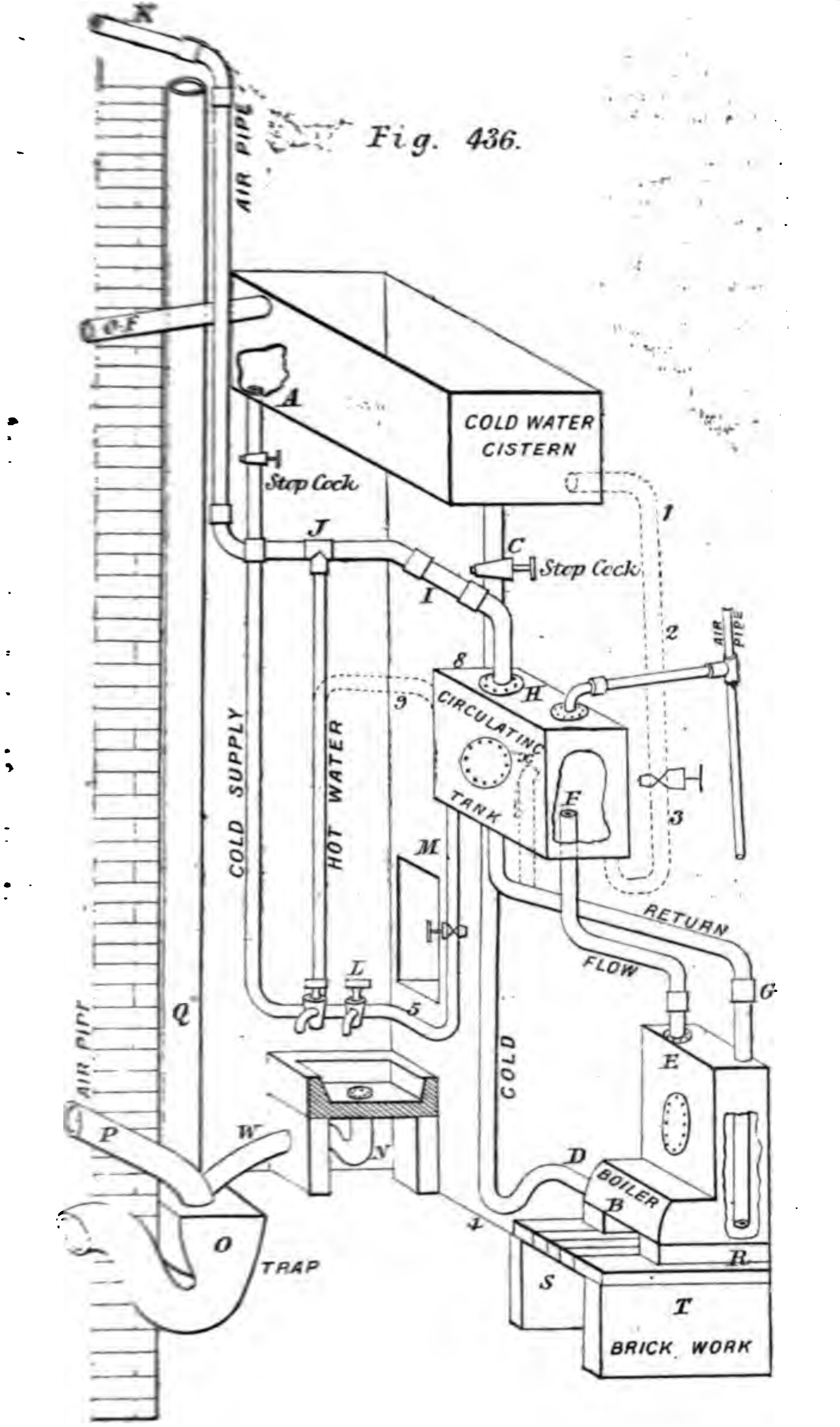


supply pipe M to the top of the hot water tank, and branch it into the top *corner* of the tank at E. Then, in this case, it will be impossible for the hot water to be drawn off by the inlet pipe. Many will say that this system is contrary to that generally in use. So it is. But let this be as it may, the system works exceedingly well, and often may be fitted when needs drive. J J is the draw-off pipe from the hot-water tank, which, being continued forward to AIR PIPE and to X, carries off all steam and allows the air to flow from the hot-water tank when it is being filled with water. It should be *properly protected from frost.* I do not like this style of drawing off the water from the tank, but prefer to fix the draw-off pipe about 3in. to 6in. down the tank, as shown at the dotted lines 9, as this prevents the air being drawn down with the water when in use.

HOT WATER is this pipe, branched off the above-mentioned air pipe, and which I object to supply the sink.

In the preceding few chapters I have drawn your attention to the hot-water fitting such as is done by plumbers, &c., generally, and which I will assume that you are, in practice, tolerably well acquainted with; but, if I were to ask you the reason why such apparatus works, the chances are that I should receive an unsatisfactory answer; and to enable you to thoroughly understand this class of work, so as to be able to fit up works of every class, it will be imperative that you should thoroughly master the principles which govern this important branch of your work, so that you may not be, as many of our leading foremen of plumbers are, simply obliged to come and seek information which, I say, every apprentice boy should be able to give before he is out of his time. I may also state that I have, by the plumbing craft, been asked to thoroughly explain the theory of hot water work, together with the practical part, not only suitable for the apprentice boy, but also for the foreman and master.

The Theory of the Circulation of Hot Water Through Pipes, &c.

It will be seen that heat is diffused through water in a very different manner to what it is through solid substances. When the heat applied to the bottom of a boiler or other ves containing water, the first effect is to expand t nearest layer of water to the fire. The fire, reason of its heat, makes this layer of wa specifically lighter than the colder water whi may be by the sides, and especially that abov and these layers being lighter than the co above, it allows the colder water to descen when the hot water naturally rises, or floa upon the molecules of the colder or denser wat which surrounds the hot; then the cold wat from above, by reason of its extra density, imme diately sinks to the bottom of the boiler, when i again becomes heated and again lighter in it turn. These succeeding fresh layers of heate

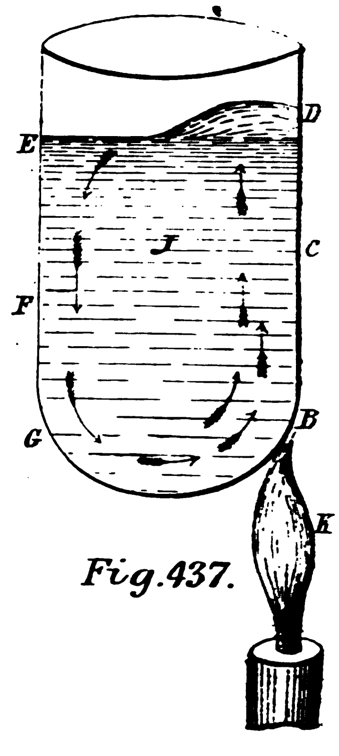


Fig. 437.

water will continually carry the *heat from the* bottom of the boiler to the highest *point of the* circulating tank, which heat, *if the pipes* and tanks be not too large, is finally and gradually diffused through the whole of the water within such pipes and tanks.

For an illustration of this beautiful system, I will ask you to take an ordinary tin can, or, better, an oil flask or other bottle, and nearly fill it with clean water, into which put some bran or other light substance which will not altogether float; then put it over an ordinary gasburner lamp, candle, or other fire, so that you may be able to watch the action of the water. You will see that from the first moment the bran, &c., will be in motion, rising upwards just above the heated part, and, as shown by the arrows B C D, Fig. 437, and downwards at the colder sides, E F G. Place the candle on the other side, and the action will be reversed. Place the candle in the centre of the glass, and the upward motion will be in the centre. Having got so far, next try this experiment with a bent glass siphon, as at Q P W S, Fig. 438, which may be made from an ordinary glass tube, procurable at most chemists, who will also bend it for you, or you may do it yourself, by making it red hot over a fire; or, if you cannot get this, procure a pail or a deep saucepan, and bend a piece of compo. tube to the shape; let the bottom leg go to the bottom of the saucepan, but cut on the splay, so as not to stop the water way, let the short leg just dip an inch or two into the water. Now fill the syphon *quite full* of water, and put the two legs into this water, as shown. Set the pail over a fire, and you will soon find that the siphon will be the hottest, showing that, by reason of the extra length of water in the long leg, the action of the water is more rapid through the siphon than that within the pail, and well establishing the fact that the hot water will travel through any length of pipes as at FLOW and RETURN, Fig. 436.

(*To be continued.*)

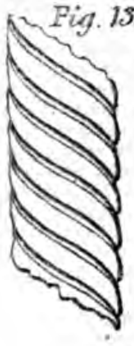
PATTERN MAKING.—XXI.

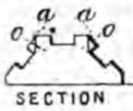
Fluted and Ornamental Columns.

THESE, at first sight, would appear to present insuperable difficulties in the way of moulding. Looking at an architect's drawing, which somehow always does look more elaborate and enigmatical than the actual thing it represents, we wonder how such a complicated mass of ornamental work is to be got out of the mould. The pattern can be made like the drawing; but how to reproduce it in the casting is the difficulty. Drawbacks would perhaps appear feasible on first thoughts; but a little consideration usually reveals practical difficulties in the way of their adoption, and in most cases we are reduced to the method of loose pieces, as being, on the whole, the least troublesome.

We take then a fluted column like that shown in sketch, Fig. 127. Here we have a square base with mouldings, above that a fluted portion, then moulding again; after that a long fluted shaft, surmounted by an ornamental capital. It will be observed that the column in this case varies very much in diameter, being about twice as large in the lower portion as in the upper. The first thing necessary will be to strike out the column to full size, first in longitudinal outline, indicating the thickness of metal by dotted lines, and then in cross sections, Fig. 127, at A A, B B, C C, to show the flutes. To make the pattern, we want a steady foundation—not the actual pattern, but that on which the pattern is to be built. Upon this base the fluted portion will be laid in strips, which strips will be drawn in succession from the sand, after the base is withdrawn. A glance at the section, Fig. 128, will make my meaning clear. Divide the circle into such a number of parts that the flutes will draw readily from the sand; thus, a strip so wide as that shown in Fig. 129, could not possibly be drawn away without tearing down the sand at a a. Let the edges, then, of the extreme flutings be plenty free enough, and do not, for the sake of minimising the number of joints, make the pieces so wide that opposite fluted edges will be *undercut* in relation to each other. There will not be less than six in any circle: eight are better, and in some cases twelve are desi We will have eight in this column. Divid

Fig. 135.





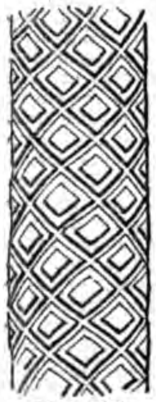


Fig 139.

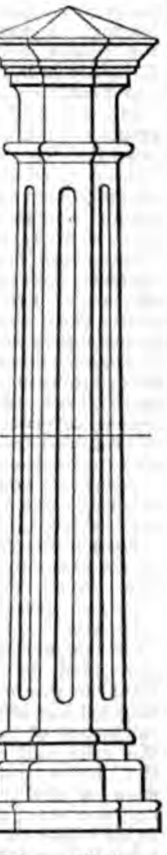


Fig. 136.

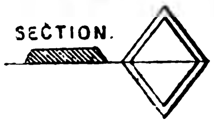


Fig. 141.

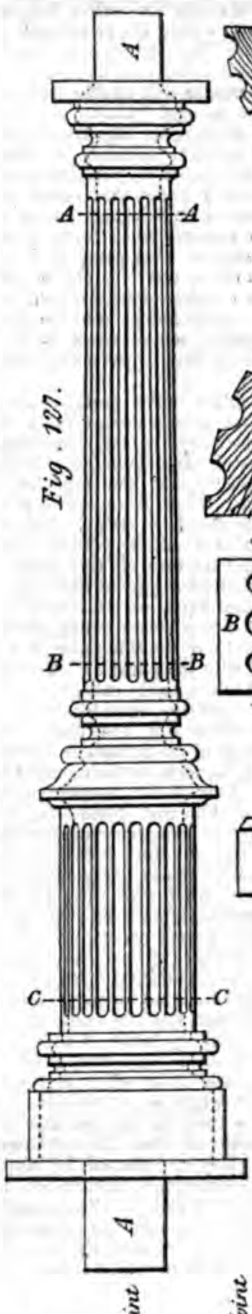


Fig. 127.

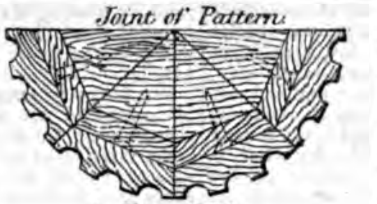


Fig. 128.

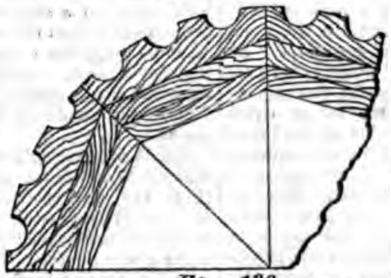


Fig. 130.

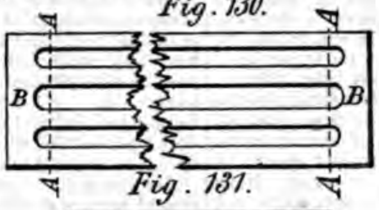


Fig. 131.

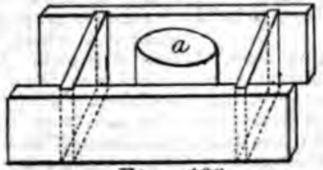


Fig. 133.

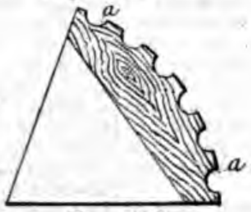


Fig. 129.

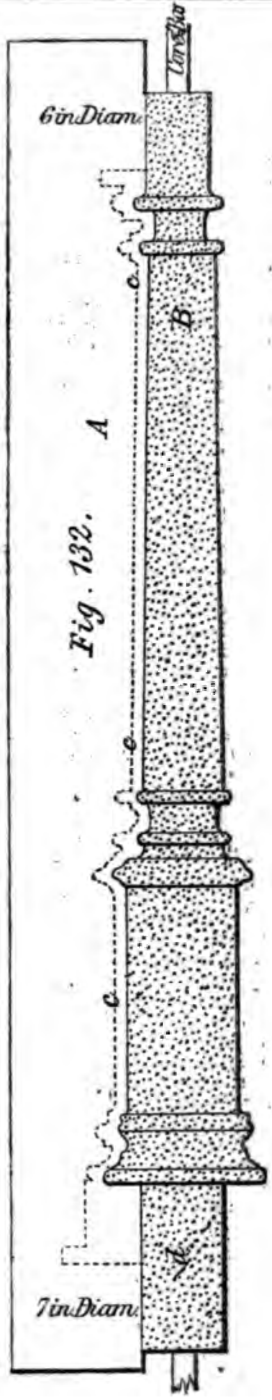
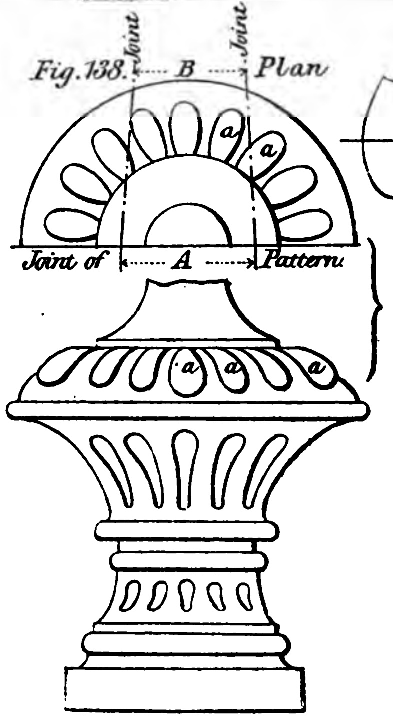


Fig. 132.

Fig. 138.



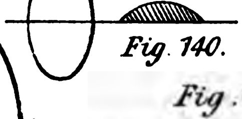


Fig. 140.

Fig. 134.

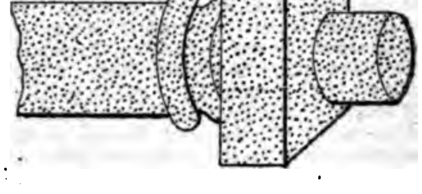
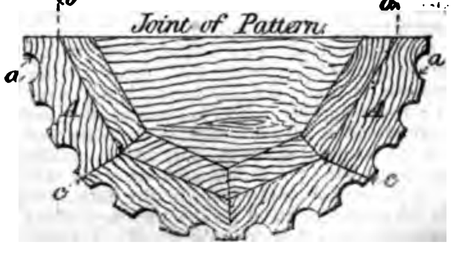


Fig. 137.



[illegible] prism was slowly rotated by clock-work [illegible] whether the analyser was whirled round [illegible] times per minute in order to produce [illegible] effects of polarisation.

[illegible] to the binocular instruments there were [illegible] in which not only the tube was as [illegible] halved to form two, but the object-lens itself was actually cut in half. One was so arranged that the two half-tubes and half-lenses would fold together and form a monocular. Here were also the old specimens with parallel tubes, and the modern instruments with their converging tubes. Devices for exhibiting a series of objects arranged on a rotating plate or on a sort of water-wheel had numerous representatives. A gigantic specimen of brass barrel-organ, that once figured at one of the International Exhibitions at the modest price of £300, has found a resting-place in Mr. Crisp's collection. This monster shows some 500 objects, bringing each in turn before the gazer, with its name appended.

For special work, tank microscopes, possessing a power of moving into almost any position and of stretching out to unexpected distances, were met with. For examining the throat and bladder there were instruments specially devised. One long, rod-like microscope, carrying its own electric lamp and a cold water coil to keep the lamp cool, could be passed down the throat into the stomach, so that the progress of such diseases as cancer of the stomach could be watched. Mr. Crisp sought in vain amongst the members for one who would swallow the apparatus in order that the remainder of the guests might survey his interior anatomy. Another microscope clasped the human tongue tightly, so that the circulation of the blood could be seen in that organ. For counting the varying number of corpuscles in the blood of the healthy and diseased, there was ready all the apparatus required. Methods of lighting—oil, gas, and electric—diaphragms, reflectors, condensers, hot stages, electrical stages, live-cells, and all that appertain to microscopy, found there a place. The museum is a very maze of brass. Fabled Argus, could he but stroll in there, might fit himself a tube to each one of his [illegible]00 eyes and then not gaze on empty shelves. A library containing a polyglot assemblage of microscopical literature told of the ancient and modern marvels wrought by the strange forms of brass and glass close by.

In answer to the question: Need the worker of the microscope despair because he cannot command all this wealth of ingenuity? Mr. Crisp replied by taking up a small binocular microscope, costing about [illegible], and remarking "That is what I should work with." The discoveries of science have been made by means of simple and inexpensive apparatus. After inspecting so unique a collection, the question naturally arose: Has the microscope attained perfection? Many hold that it has, and that unless we get some material of higher refractive index than glass, we cannot hope to get much beyond our present power of making visible the unseen. But the same [illegible] finality has been pronounced [illegible] every age of every art. It is true we do not [illegible] in what direction to look for any advance as regards the microscope, but none the less it may be [illegible]. Mr. Crisp's collection shows what has been done and is being done for the perfection of the instrument; it thus warns the inventor of the [illegible] of the past, and concentrates his powers on [illegible] for further improvement.

Amongst the members present were Prof. Grylls [illegible], F.R.S., Mr. W. Saville Kent, [illegible] Dr. Lowne, Dr. Millar, Mr. Pascoe, F.L.S.; [illegible] Rev. Prof. Henslow, Dr. Waller, [illegible] Tubbs, &c.

[illegible] of the Oceans of the World.

[illegible] by Dr. Otto Krummel, of Gottingen, [illegible] of the different seas on our [illegible]. According to his calculations, the Atlantic [illegible] superficies of 10,1[illegible]9,468 square miles, [illegible] Ocean, [illegible] square miles, Pacific [illegible] square miles. Thus the total [illegible] three large oceans is 1[illegible]4,[illegible]87,42[illegible] [illegible] Arctic Ocean has a superficies of [illegible] miles. In the Arctic Ocean, [illegible] superficies of [illegible] square [illegible] square miles, the [illegible] square miles, Mediter[illegible] square miles, Baltic, [illegible] Sea, [illegible] square miles, [illegible] square miles. Then come [illegible] smaller coast seas, viz., [illegible] square miles, Sea of Great [illegible] miles, Sea of St. Laurent, [illegible] China Sea, [illegible] square [illegible] square miles, Sea of [illegible] square miles, Behring Sea, [illegible] Sea of California, 19[illegible] [illegible] superficies of these coastal [illegible] miles. Adding the Antarctic, [illegible] of which is calculated at [illegible] the total superficies of all [illegible] square miles, while the total [illegible] continents and islands of the [illegible] square miles.

SCIENTIFIC NEWS.

◆

THE death is announced of Dr. John Hutton Balfour, Emeritus Professor of Medicine and Botany in Edinburgh University. The deceased, who was a member of many learned societies, was born in 1808, and was for a few years Professor of Botany at Glasgow. His son, Prof. Bayley Balfour, was recently appointed to the chair of Botany at Oxford.

The death is also announced of Prof. Arnold Henry Guyot, the distinguished geographer, who was born at Neuchâtel in September, 1807. Guyot was a student-friend of Agassiz, and after studying glacier and other formations in the Alps for several years during his summer excursions, he emigrated to the United States, and settled at Cambridge, Mass. Guyot was employed as a lecturer in the normal schools by the Massachusetts Board of Education, and by the Smithsonian Institution as organiser of the system of meteorological observations. In 1855 he was appointed Professor of Physical Geography in the College of New Jersey, at Princeton, which post he retained until his death. Perhaps his most important work was the investigation of the erratic boulders of the central Alps in Switzerland and Italy, which he traced over a surface 300 miles long and 200 miles wide.

We have to acknowledge the receipt of the useful "Annuaire de l'Observatoire Royal de Bruxelles," which in its 51st year is full of interesting papers on astronomical subjects, relieved by readable papers on, for instance, the "Most Ancient Towns of Europe," by J. C. Houzeau, the "Rain in Belgium," by A. Lancaster, and the "Tides on the Coasts of Belgium." There are a couple of lithographed plates to illustrate papers on the Transit of Venus, as seen from Texas and Chili.

We have the abstract of the Proceedings at the fourth meeting for the session of the Liverpool Astronomical Society, which, amongst other matters of interest, contains a lithographed plate of Fracastorius and the neighbourhood by Mr. W. Goodacre, director of the Lunar section.

Profs. Anton de Bary, Gegenbauer, L. Kronecker, Virchow, and Wiedemann have been elected foreign members of the Royal Society.

Mr. T. Bolton, of Newhall-street, Birmingham, has issued his tenth "portfolio" of drawings of microscopic animals, and calls attention to the fact that two of the subjects were new to science when he first sent them out. These are Chilomonas spiralis and Asplanchna Ebbesbornii, the latter having been discovered by Mrs. Tupper Carey at Salisbury last August. Raphidiphrys elegans is also believed to be a new find, and Hemidinium nasutum has not been previously figured.

The difference between lard and fat described as tallow is now settled in the United States by the microscopic test discovered or utilised by Dr. W. T. Belfield, of Chicago. Examined as an expert witness in a trial in connection with lard adulterations, he said that pure lard crystals are thin rhomboidal plates, while those of pure tallow have curved forms somewhat like the italic letter *f*.

The United States Bureau of Weights and Measures constructed for the American Society of Microscopists a standard micrometer of platino-iridium (80-20). Prof. W. A. Rogers tested this "standard" during seven months, and it is now kept by the society, who allow it to be used for comparing other micrometers on payment of a fee.

Our correspondent "Devonshire Squire," in sending us a very fine sample of the dried leaves of *Chimonanthus fragrans* (see p. 22 ante, and p. 579, last volume), says that he finds the tea made from them in the usual way has "much the flavour of ordinary green tea; certainly less good than the best, but fully equal to much that is sold under that name. It also seemed (but I may be wrong as to this) to impart a peculiar exhilaration to the nerves." We can corroborate "Devonshire Squire" as to the flavour, which is certainly superior to that of much of the coloured stuff sold as green tea (fine samples of which cost 4s. a pound), but we have not tried the effect on the nerves. There is a peculiar, but not unpleasant, bouquet with the Chimonanthus tea, and it is not impossible that if the leaves were dried by heat like China tea, it would be found as well worth cultivating as an economic plant, as it certainly is as a flowering shrub. It is commonly known as the Japan allspice, and should be in all gardens where it can have the protection of a wall.

M. Wroblewski has, it is reported, succeeded in producing both liquid and solid oxygen in considerable quantity. The liquid boils at −1[illegible], and forms into crystals. Its critical temperature at a pressure of 50 atmospheres is − 113°C.

The parts of a human skeleton found at Tilbury last year, which formed the subject of a paper by Sir R. Owen, read before the Royal Society, have given rise to a lively discussion in certain scientific circles. Sir R. Owen's views are supported by evidence of the close association of the human remains with palæolithic objects found in the neighbourhood; but other authorities are inclined to the belief that the bones belong to a neolithic period. Extensive excavations are being made in the neighbourhood and it is possible that more light may be thrown upon the question.

In a communication to the Academy of Sciences, Paris, MM. Houlès and De Pietra Santa report that they have been unable to discover any injurious action on the health of workmen engaged in working in copper, and they conclude that colique de cuivre does not exist.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

A COMMENDABLE MEASURE—THE ARMAGH OBSERVATORY—AN AUTHOR WHO DID WRONG WHEN HE DID WRITE (ON ASTRONOMICAL SUBJECTS)—SUNRISE ON THE CLUN STONE CIRCLE—LUNAR CYCLES, &c.—MEASUREMENT OF THE POWER OF A TELESCOPE—NAKED-EYE OBSERVATIONS OF THE HEAVENS—LEGAL—THE CRESCENT MOON.

[23331.]—I SEE that it is stated in the newspapers that "the International Institute for Preserving and Perfecting Weights and Measures will soon send five scientific gentlemen, elaborately equipped, including one Englishman and one Frenchman, to remeasure the Pyramid of Ghizeh, and especially to uncover and examine the foundations of it, and of the Sphinx, with a view to settle finally differences between reports of earlier observers, and particularly to supply material for re-enforcing the established weights and measures against the progress of the metric system." Beyond the fact that the Institute is an American one—or, at all events, has its head-quarters in the United States—I know nothing about it, and shall be glad to hear from any of my brother correspondents on the other side of the Atlantic, something as to the amount of deference to be paid to its decisions. Should it turn out that they carry weight and authority, I can hardly fancy a more interesting or important work than that which the Institute has imposed upon itself. To get, once for all, accurate measures of Pyramidal details, made by men who have no theory to support, would be, I fancy, to give a coup-de-grace to the innumerable crazes concerning its quasi-supernatural origin, which have been, and are, from time to time paraded. As for the effort to stem the progress of the metric system, it will have the heartiest sympathy of every one in this country who is unconnected with South Kensington. That the British yard and inch should ever be superseded as units of measurement by subdivisions of an erroneously determined quadrant of a merely local meridian, would be as discreditable to Englishmen as it would be ridiculous and unnecessary. Somehow, though, I fancy that measures which have been in use in this

Maclean spectroscope, which does not seem to have been seen in that position by other observers.

The night of Feb. 2 was a good instance of the lightness of nights to which I drew attention on p. 333. Through the evening, while the crescent moon was up and after she set, it was as dark as usual, but when I went out to the observatory again at 1h. there was a great contrast. Everything in the observatory was quite plainly to be seen, and I could comfortably move about and get things; in fact, I could almost have written my notes, for the book was plain, though I could not have seen the pencil marks. Out of doors, buildings, trees, plants, and the gravel walks, both near and at a distance were quite distinct. But the definite test of the amount of light is that at ten minutes to two, standing up at the open shutter, I could read the time by my watch. It has a white face, and is 1¾in. in diameter. The only guide I had to the time was that I knew it was some time after half-past one. The light was colourless, and exactly like the first beginning of dawn on a fine starlight night. The sky looked whiter than usual, but there was no perceptible mist. The stars were brilliant, and faint ones were well seen in numbers, though the sky was not as crowded with them as sometimes. The definition of Jupiter and Mars was good, and they were very brilliant. The lightness lasted at least until 3 a.m., then I came in, and when I went out again for further comet-seeking, at 5 a.m., it was as dark as usual. The night was dry and calm, without a cloud. The thermometer went down to 28° at 1h., and still further to 25° at 5h. 20m. It was the first frost we have had for some time, and we have not had another since. The light of the dawn at 6h. 30m. seemed to me equivalent to the amount of the other light. It was the first night clear throughout that we have had for some time. **M. A.**

STAR MAGNITUDES.

[23333.]—In his estimates of the brightness of comet Pons-Brooks (letter 22313), Mr. Hennessay says that his estimates of the comparison stars differed in some cases from those given by Heis. The following magnitudes, found by Professor Pritchard with the "wedge" photometer, will show that Mr. Hennessay's estimates of relative brightness were quite correct:—

γ Pegasi	2.47	Heis 3-2.
α Andromedæ	2·05	Heis 2.
τ Cygni	3·68	Both 4m. Heis
κ Cygni	4·23	

I have compared the magnitudes given by Mr. Gemmill (letter 22312) with Professor Pritchard's results, and find a generally fair accordance. The following are the most remarkable discrepancies—recollecting that Professor Pritchard's standard is Polaris = 2·05, and Mr. Gemmill's Polaris = 2·2:—

	Gemmill.	Pritchard.	
α Ophiuchi	2·0	2·23	3m. Sufi, 3m. Houzeau.
ν Cygni	4·0	4·23	
ζ Cephei	4·2	4·32	
κ Cephei	4·3	4·50	5—4 Sufi, 4·8 in *Durchmusterung*.

With reference to the magnitudes he quotes from Heis and Argelander, I find the following discrepancies (the scale of Heis and Argelander being the same as that of Pritchard):—

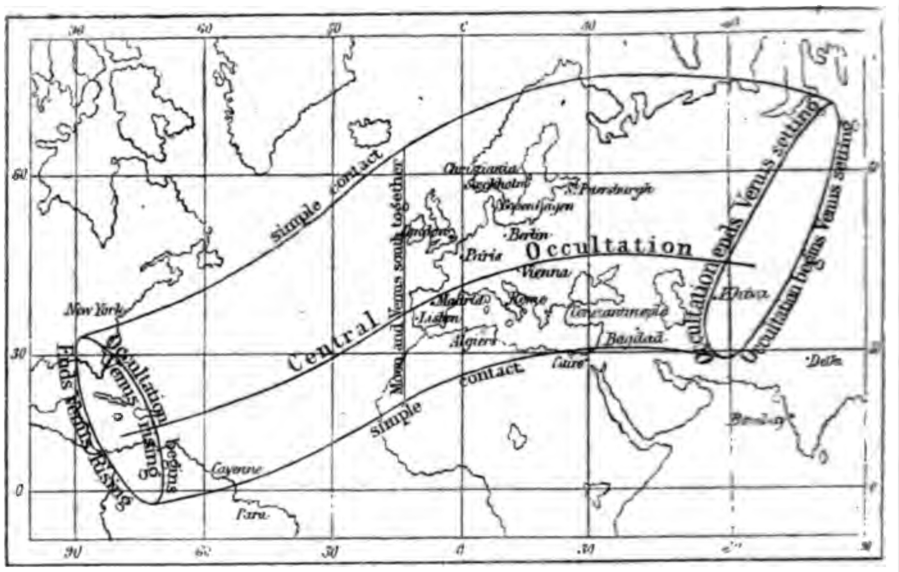
	Gemmill.	Pritchard.	
α Cygni	1·7	1·35	This in Gemmill's scale would be 1·50.
Castor	1·7	1·48	
β Herculis	2·3	2·67	Suspected variable.
ζ Leonis	3·0	3·39	
ν Ursæ Maj	3·3	3·50	
λ Orionis	3·3	3·52	Suspected variable, Gould.
χ' Orionis	4·7	5·10	5·4 in *Durchmusterung*.

I should add that Prof. Pritchard's results are "zenithal magnitudes."

9th Feb. **J. E. Gore.**

OCCULTATION OF VENUS.

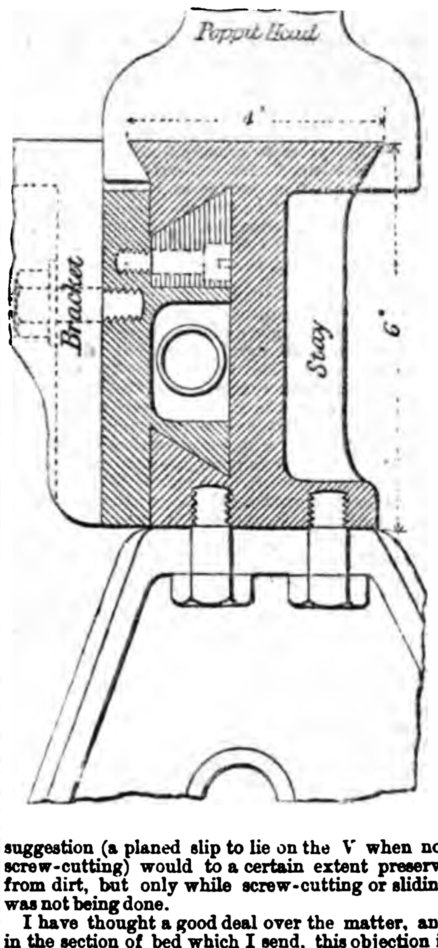
[23334.]—Venus will be occulted by the Moon on the 29th inst. As the phenomenon will be visible in the whole of Europe, the annexed chart, taken from *l'Astronomie* will, perhaps, interest our astronomical readers. It has been worked out graphically by Mr. E. Blot, of Clermont (Oise), and shows by simple inspection in what places the phenomenon will be visible. At Paris the occultation will last from about 3h. 13m. to about 4h. 33m. p.m. The phenomenon will easily be *seen with a telescope*. The planet will disappear at about 55° east of the Moon's north pole, and reappear at about 100° west. **C. Detaille.**



THE FRONT SLIDE LATHE.

[23335.]—Mr. Bear's statements as to the action of the front slide are most valuable, coming from one of such experience. One hundred years' wear, I think, ought to satisfy most of us. So we may regard the question of abiding accuracy as settled.

We may pass by the objection of general appearance, as hardly worthy of being set against convenience. The V slot being a receptacle for chips and turnings, and also being oily, as the Britannia Co., in a private letter to me on the subject have pointed out, is a thing to be considered. Their suggestion (a planed slip to lie on the V when not screw-cutting) would to a certain extent preserve from dirt, but only while screw-cutting or sliding was not being done.



I have thought a good deal over the matter, and in the section of bed which I send, this objection is in a great measure got over, and the construction of the bed much simplified; while there are several other advantages gained, without (as far as I see at present) any serious disadvantages.

It will be seen that what I suggest is a modification of the ⌶ form of bed, which Major Armstrong proposed as suitable for his combination lathe, and which, in a rough calculation he made for me at the time, he showed to be stronger and stiffer than the ordinary double bed, supposing the same weight of metal to be in both beds.

His calculation for the breaking weight of a double bed 4¾in. gap by 5½in. wide, is 52·30; for an ⌶ bed same weight breaking strain is 61·87; while the cross resistance in the two cases would be 5·06 and 9·18, thus giving on the two counts a gain of more than 50 p.c. in favour of the single flange.

I don't think my illustration needs any explanation. The mandrel head, after Major A.'s plan, would be cast solid with the bed. The poppet fixed by his method. Several stays would be put in at back, and this bed could very easily be made with a gap.

The bracket for rest, which I have only shown in part, could be made to slide vertically on the saddle either by screw or hand, and would be fastened when at proper height by two bolts. This would be convenient for many purposes. The rest might also be made to slide forward on to top of bed, between V slots on top of bracket, and be held by a bolt as suggested by "O. V." in his first letter.

I submit this design to Mr. Bear and "O.V.," as at least solving the oil and chip difficulty, and also securing the V edges from all possibility of injury from chance knocks.

I do not know whether these modifications of Major Armstrong's design are covered by his patent; but as the Britannia Co. were, I believe, intrusted with the carrying out of his complete design, they could easily arrange with him about the adoption of any portion. At any rate, it seems it is to Colchester that amateurs must look for any help in carrying out this design.

I presume Major A. is still in India, else he might help us with his opinion and suggestions, for I cannot but think the man who designed his combination lathe is, after "J. K. P.," the one most fertile in resources suitable to amateur wants.

We will, however, anxiously look for the screwing attachment referred to by Mr. Bear, and which he thinks will be much better than the front slide lathe for most amateurs. But if I understand him rightly, the whole saddle with slide rest attached hinges over to the back, so that poppet has to be unshipped twice for each time you use the hand rest. But I suppose the cost of the arrangement will be much much less than a regular screw with saddle and set of change wheels; and with many a one that means the putting a self-acting screw cutter within his reach. **Fredk. Carre.**

MICROSCOPIC TEST OBJECTS.

[23336.]—"Monachus," in his letter (22261) has evidently misunderstood me regarding "true structure." I was not alluding to the ultimate true structure, but was speaking only of the marks that were under discussion, with which we are all acquainted, and whose diffraction spectra of the first order are taken up by even moderate apertures. I still adhere to my statement about the S. gemma. The markings on my best specimen counted transversely 55,000, and longitudinally 68,000 to the inch. The diffraction spectra of the first order from these markings would make angles in air of about 70° and 90° with the dioptric beam respectively. A $\frac{1}{12}$th, N.A., 1·43 therefore, would amply admit, with axial illumination, these—viz., the dioptric beam and one diffraction spectrum of the first order on either side of it.

If the finest lenses of the present day are unable to show the true markings (not ultimate structure) of the P. formosum, P. angulatum, and S.

methylated spirit of 82 p.c. by volume to obtain 80 p.c. by volume? Answer $\frac{50}{82}$ There must be 50 parts of spirit in 82 of the mixture, or nearly 2½ to every 2 of water. Similarly, how much water to rectified spirit of 89, to obtain 60. Answer $\frac{60}{89}$; and 89 – 60 = 29. Close upon half as much water must be added. So of 75 p.c. and other percentages.

Chromic acid, often contaminated with sulphuric acid, ought to be in the form of dry red crystalline needles. In buying it, ask that it be perfectly dry, since moisture will make it weigh heavier than it ought to do, and will thus falsify the solutions. It ought to be kept in a closely-stoppered bottle; and perhaps it is the best plan to make a strong solution of it (say 25 p.c.) at once, so as to eliminate the difficulties occurring from its vehement tendency to "deliquesce," or dissolve in the water contained in air. *Bichromate of potash* (red chromate) has properties similar to, but feebler than, those of the free acid; as also has *bichromate of ammonia*, a salt of similar appearance, which may be made by neutralising chromic acid with ammonia. Bichromate of potash hardens very slowly, but is not so apt to produce granulation as chromic acid itself (alcohol possesses the unpleasant property of producing granulation in a pre-eminent degree). Solutions of bichromate of potash have to be four or six times as strong as of chromic acid. Bichromate of ammonia acts more vigorously than the other bichromate, and has been used microscopically for brains and spinal chords; it seems to be the salt recommended by Klein as showing a fibrous network in protoplasm, especially in that of large glandular animal cells. Klein employed a 5 p.c. solution for 24 hours; then tinged with picrocarmine; and mounted in glycerine. The appearances he observed are regarded by Fleming and others as *post mortem* phenomena.

The question continually occurs, "Shall I have to use distilled water, or will good common water do?" For solutions or dilutions of the above substances, and for all ordinarily microscopical purposes, good ordinary water suffices (I find the London water gives but little trouble, except with salts of silver and of lead); but for recipes of mounting liquids, distilled water (which is very cheap) is doubtless preferable. Even the distilled water is not pure, and it will be well to see that it is free from films and sediments, or, if they are present and no better water can be had, to filter them away. Of other water, clean rain water is the best; and all water except good distilled water ought to be well boiled, allowed to stand for a few days in a full bottle, to deposit any sediment which may fall from it, and the clear supernatant fluid drained off or filtered. This boiled water also helps to take the air out of tissues. Besides its power as an ordinary solvent, water dissolves the thick syrupy substances among the tissues, and thus causes their more solid parts to stand out more boldly. It also dissolves tissue cement, or disintegrates it, though slowly; and in the first instance coagulates protoplasm, which afterwards disappears, or becomes indistinct. Hence the details of a transverse soft-stem section look more distinct after an hour or two, but finally become blurred and unintelligible. Of its power of swelling and bursting cells, mention has already been made.

II. *The Process of Hardening.*—In hardening, the first thing is to make sure that the object is thoroughly penetrated by the hardening agent. The fresh object, therefore, has to be cut into pieces of not more than half an inch, or so, in their greatest thickness, the precise size depending on the hardness and density of their tissue, since, otherwise, the interior may remain soft, or even putrefy. Alcohol penetrates more rapidly than chrome solutions; it also possesses greater preserving power, so that with chrome solutions the pieces must be cut smaller. Air will also prevent the entrance of hardening agents, and alcohol removes it better than watery fluids (though they also do this, especially if the water has been boiled), so that stems, &c., may be slit down before immersion. The next thing to provide against is, that the action, though finally complete, shall not be too violent. If this is not attended to, the exterior of the object, by the greater firmness communicated to it, may prevent the deeper penetration of the fluid; and besides, a hardened object is really a *remarkably firm clot*. The albuminous matters are coagulated and contracted, while with alcohol they are contracted by the removal of their water as well; and if this clotting is violent, they preserve nothing of their natural form, but the object is seen, when examined microscopically, to present little more than a multitude of granules or clots, giving it a mottled appearance in which almost every trace of the original structure is lost. The proper precaution against these dangers is to increase the strength of the fluid gradually, so that the slight coagulation effected by the first and weakest dilution, while too inconsiderable to give rise to any appreciable *denaturalisation, may com*municate a solidity sufficient to protect against distortion by the next, and so on till the hardening is completed. Consequently a beginning is made with spirit containing 45 p.c. or less alcohol, if alcohol is the agent employed, while with chromic acid, although the solution *may* be as strong as ·2 p.c. with coarse and stable tissues, it may be as weak as ·02 p.c., especially where it is desired to clear up contained tissue elements. After this has had time to penetrate thoroughly—say, in a couple of days, the length of time required will depend on the size of the pieces and the permeability of the tissue—the solution has to be changed for another nearly twice as strong for chromic acid, or with alcohol, containing about half as much water (75 p.c. alcohol for three days or so). This changing has to be repeated till the objects lie in pure methylated or rectified spirit, or, if obstinate, in even stronger alcoholic fluid; and, with chromic acid, till a strength of ·5 or 1 p.c. has been reached. In this they may have to remain for weeks before the requisite hardness is attained. They should at last feel like fresh radish, and may be taken out from time to time to see how hard they are, while part may be left in longer, to see how hard it will become. Over-hardened objects are thready, brittle, pulverulent internally, or notably shrunken. As a rule, objects which stain more rapidly also harden more rapidly.

Spirit is preferred for glands, the digestive organs, "lymphoid" tissues, and morbid growths, which decompose with extreme rapidity. It also penetrates vegetable tissues and expels their air, as has been said; but small delicate vegetable objects harden well in chromic acid, and so do soft roots. Objects, moreover, often harden better when two different agents are employed than when the whole of the process is trusted to one only; so that spirit is often used to complete hardening commenced by chrome solutions. It is also recommended to begin with bichromate of potash, and follow it up by chromic acid, which is more powerful, and less easily managed as to the precise strength to be employed. Chromic acid is preferred to spirit for nervous tissues and organs of sense, and also where the object is partly composed of bone, as in the internal ear. It both hardens the more delicate tissues, and softens the bone by decalcifying it, so that on account of the more uniform texture thus produced, sections are more easily cut. Chromic acid and other chrome solutions have the disadvantage that they communicate to objects unpleasant tints which interfere with the subsequent staining, though less so where hæmatoxylin is employed. If used too strong, practically irremovable deposits are also left in the tissues. The colour is removed or diminished by washing or steeping in spirit, especially if a little acetic acid is added. Both alcohol and chrome solutions render objects more opaque from coagulation, the latter also by colouring, or, additionally, by the deposits just mentioned. If the objects are to be mounted resinously, the processes employed will doubtless sufficiently clear them; if not, steeping in glycerine and acetic acid will do so.

The following points deserve notice:—(1) Spirit or chromic acid which has been already used for hardening, and, consequently already contains a certain amount of albuminous matter, acts less harshly than what is raw, and may be first used. (2) The fluid used ought to be of six or eight times *the bulk* of the objects, or its power is exhausted in a few hours; time is wasted, and putrefaction invited. More of a weak fluid acts like less of a strong one, except that the latter first works energetically, and then does nothing. (3) To insure gradual action, the objects may be wrapped in moist cotton wool (recommended by Cole with chromic acid); glycerine may be added, or, as recommended by Beale, the chromic acid solution may be made with glycerine instead of water. In this case the object must be cut very small, on account of the low penetrating power of glycerine. (4.) To guard against incipient decomposition, a little spirit, chloroform, or both—a quarter, or more, of the former, or ·5 per cent. of the latter, may be added to chrome solutions. For the same reason, all hardening objects must be kept well corked or stoppered up. (5) In decalcifying, more than 1 per cent. chromic acid may be employed; but much more may be risky, inducing brittleness, especially in fresh objects. Its action, however, may be eked out by adding a few drops of nitric or hydrochloric acid to the ounce of solution, or, what comes to the same thing, a 2, or even 3 or 4 per cent. acid may be shielded by being dissolved in glycerine, which will also give it a longer time to act in, by protecting against decomposition. The requisite quantity of the strong 25 per cent. solution may be mixed with glycerine. (6) A solution which is notably turbid, or has become highly coloured, should be changed. Its strength is being consumed on matters drawn out of the object. And finally (7) hardened objects need not be used at once, but may be transferred to 45, or so, per cent. alcohol till wanted.

III. *Wet Mounting.*—The general features of this process are the same as those previously described for resinous mounting. The following are the special points to be attended to:—

Firstly, steep the object for some time in the fluid in which it is to be mounted. For this there are two reasons, besides that mentioned above: First, where glycerine is used, the stronger the glycerine is, the better, of course, it preserves, while the objects move less in denser fluid (if they are not rendered immovable by being pressed between the slip below and the cover above), and are thus less liable to be damaged. If, however, delicate objects are put at once into strong glycerine, they simply collapse; but if transferred gradually from weaker (20 p.c. or so) to stronger solutions, they recover themselves after each bout of contraction. The rationale is here the same as that of gradually strengthening hardening fluids; indeed, a little of a hardening agent may usefully be added. Another advantage of steeping in glycerine is that it often *uncurls*. For instance, exceedingly thin wood sections may be cut as Sachs recommends, by hardening in spirit and allowing to dry, or with a section cutter, by moistening the wood and the razor with glycerine and as much spirit as suffices to make this run. A thin wood section almost inevitably coils up into a minute roll, if it is horizontal or transverse; but by steeping in glycerine it flattens again at least sufficiently to be flattened further by gentle handling with two small camel-hair pencils. The first reason for steeping, then, is to avoid subsequent collapse; the second is that the object may render the mounting liquid opaque from the precipitation of small particles contained in its juices. If this happens after mounting, the slide is, of course spoilt; if it is allowed to take place before, the fluid must be repeatedly changed till it occurs no longer and the object clears again. It need scarcely be said that, independently of opacity occurring in this way, the object itself may be opaque, from its nature or the thickness of the section. This may often be remedied (with bleaching, it is advisable to remove colouring matter) by introducing caustic soda or acetic acid into the preparatory steeping fluid; but soda must be carefully and entirely removed before mounting. The complete removal of acetic acid is not of so much importance; but if either of these reagents has been employed, their specific effects (which have been already described) on the tissues must be allowed for, and the specimens must not be compared with others in which they have not been applied without their results having been discounted. But thick sections are best treated by Canada balsam mounting, which clears them better than glycerine or Canada balsam and chloroform, or benzol, and much better than the thin fluids also used in wet mounting. At the same time, a thick section is not objectionable chiefly *on account of* its opacity; that, as we have seen, can *be removed*, if it is not scandalously and unbearably *thick*, as the first sections are likely to be. The principal objection to it is that it is confusing, and does not show the details, being layer over layer. *Secondly*, having sufficiently steeped the objects, put a thin layer of gold size or Bell's cement on the cells which are to receive them. Have some cells, then, prepared as described in the first of these letters, but dry and hard, not waxy, so that they will not injuriously give or change shape after the covering glass is applied. It is well to have a number of cells ready, of different sizes and depths, as they may be wanted on occasion; and one of greater depth or dimensions than is necessary to contain the object with a due amount of clear space round it ought not to be used. For the object might then swim loosely about in the interior of the cell after mounting, be difficult to focus, and liable to injure itself in its movements, or to escape out of sight; and again, small cells hold better than large ones. The reason why shallow cells are longer lived than deep, and cells of small than those of large diameter, is that the suction of the contained liquid when it contracts with the cold of winter, and its outward pressure as it swells with the summer's heat, are smaller in comparison with the resisting power of the cement inclosing it. Hence, large cells burst or admit air-bubbles by contraction, while lesser ones, or those more thickly coated with cement, remain firm; and so, also, gold-size cells are more likely to hold than vulcanite rings, and vulcanite rings than glass cells, which accommodate themselves least to variations of temperature and pressure; metal cells hold well. For the same reason, all variations of temperature (those of atmospheric pressure cannot be avoided) are bad for a microscopical cabinet, which is, therefore, best kept where it is never very hot and never very cold. Besides, a cabinet ought not to be made of cedar wood, or any wood containing turpentinous matter. The reason why the top of the cell should be covered with a thin layer of cement is that the cover, when applied, may be capable of being worked down a little way into it, forming a kind of shoulder-joint, so as to effect a more perfect juncture. To make the top of the cell of the same level all round, it may be gently pressed with another slip, moistened with water or glycerine, to prevent accidental adhesion; and a way out for but Cui bono? The mere statement of the tractive force cannot be of much use, unless something is known as to the rate at which the engine can move while exerting it; and directly this element is introduced, the conception of horse-power becomes applicable to the work. An engine with a traction of 9,000lb. would be no use, practically, if she could, by reason of short supply of steam, only exert that force at the rate of a mile an hour. I wonder "Historian" does not see that his determination of tractive force is of little value until has been found (by experiment I suppose) the speed at which the engine can run. So far from horse-power being an unpractical form, it is much more practical than tractive force. I gave an equation some time ago, in which the speed of an engine with a given load, on a known gradient, was determined from the horse-power and train resistance, and it would not be possible to make any similar determination from tractive force only. I hope, in future, that correspondents will do what "Historian" and I alike agree would be useful, i.e., send statements as to the actual performance of engines of given dimensions: this would greatly enhance the value of the replies, many of which are now of a very trivial nature. No one admires more than I do the magnificent pieces of mechanism, which we owe primarily to the genius of the Wylam mechanic; but I confess to not feeling much interested in learning that No. 843 has been painted green. On page 429, I stated that I wished to have the opinion of Mr. Stretton as to the accuracy of the calculation on page 386. He seems to have overlooked this request, and I desire to draw his attention thereto. The dimensions were given by him, and I want him to check the work.

Elswick Science School. **Wm. John Grey.**

G.E.R. GOODS ENGINES.

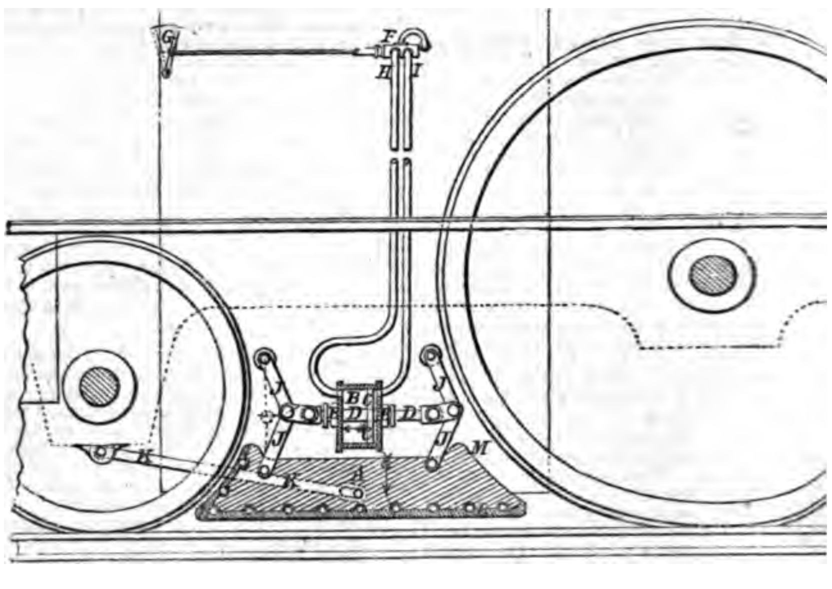
[23345.]—The following are chief dimensions of the fast goods engines, designed by Mr. Adams, and illustrated in my letter 21581, p. 411, of last volume:—

	ft.	in.
Cylinders	18in. by 26in.	
Inclination	1 in 18in.	
Diameter of driving wheels	6	1
" bogie "	3	1
Bogie centres (apart)	6	0
Rear bogie centre to driving wheel centre	8	6
Driving wheel centre to trailing wheel centre	8	6
Total wheel base	23	0
Boiler centre to level of rail	7	0½
Length of frames	28	3

The boiler barrel is 11ft. 6in. in length, and the firebox 6ft. The connecting-rods are of the same length as those on the large single bogie express engines, 245 class, the distance between centres being 7ft. 6in.

I can, if desired, send a further sketch of these goods engines, since the first was defective, which will serve to correct, and to show to better advantage, their very fair dimensions and powerful appearance. **F. W. Brewer.**

M'CONNEL'S STEAM SLEDGE BRAKE.



[23346.]—Attention has recently been directed to "sledge brakes." I therefore send a diagram and details of McConnel's system, which was patented 26th February, 1857 (No. 591.)—It consisted of two sledges (A) usually 4ft. 6in. in length, and 4in. wide, one fitted to each side of the engine between the driving and trailing wheels; a steam cylinder (B) 9in. diameter was also placed horizontally as shown on the drawing. Each cylinder contained one piston (C) fixed to a rod (D) which passed through both ends, stuffing boxes (E) were therefore provided upon both covers. Steam from the boiler passed to the slide-valve F, and by means of the handle G, the driver could admit it to either pipe (H or I), and consequently to either end of the cylinder (B), or he could close all communication.

The action of the brake was as follows:—When steam was admitted to the front end of the cylinder by the pipe (I), it caused the toggle joints (J) to straighten, or partially straighten, and this had the effect of pressing down the sledge (A) on to the rails, whilst the radius rod (K) served to draw it simultaneously against the tires of the trailing wheels. By admitting steam to the opposite side of the piston, the contrary effect was produced, and the sledges lifted up and the brake taken off.

The sledges were faced with wrought iron or other suitable material, the face (L) being bolted on as shown.

It should be pointed out that the leading end of the sledge (M) did not even touch the driving-wheels, but it is shaped so that in case of accident these wheels could not possibly mount it.

Several modifications were made by Mr. McConnell: in one, the cylinder was placed vertically instead of horizontally, and other forms of slide-valves and taps were tried. It was proposed to extend this brake throughout the length of a train; but experiments made at Wolverton with a few lengths of iron pipe proved at once that the condensation of steam would render the brake useless if applied to carriages; it therefore remained as an engine brake only.

Colonel Yolland conducted a series of experiments with McConnell's brake, 19th January, 1858, upon the Bletchley and Oxford branch of the London and North Western Railway.

	Tons.	Cwt.
Weight of engine	29	0
Weight of tender	14	10
Weight of carriages	102	9
Weight of vans	10	4¾

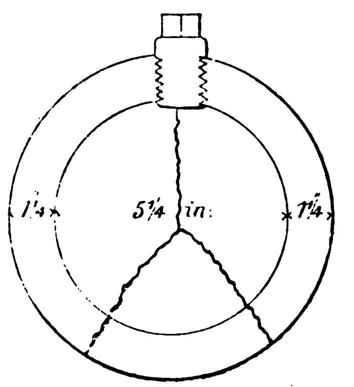
Eighteen experiments were made with the steam and hand brakes; but although the steam sledges gave a comparatively high retardation in lb. per ton of weight resting upon them, yet it was soon found that in practice all the forms of sledge brakes were inefficient and inferior to the ordinary brake-blocks pressed against the tires.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Jan. 30.

ICE-FRACTURED SHELL.

[23347.]—In conducting, the other day, one of Professor Tyndall's interesting experiments illustrating the enormous and rapid expansion of frozen water, I used a 7¾in. bombshell, whose cavity held 45 fluid ounces, the thickness of the iron being 1¼in. I placed this shell (filled with water at ordinary temperature, the orifice firmly closed with an iron-screwed plug) into a mixture of snow and salt. In 78 minutes I found the bomb broken into three pieces; the same day I burst other two shells. Two queries presented themselves: *Why* should the line of fracture in all three cases be the same, and in the case of the 7¾ shell, what pound-pressure principle had been exerted, its internal cavity being 5¼in.? Position of shell in mixture as shown in sketch. **T. R. Clapham.**



GLASS DISCS FOR REFLECTORS.

[23348.]—I think we are much indebted to Mr. Wassell and Mr. Scott for their valuable experiences. Mr. Wassell's rules as to proportion of diameter to thickness and strength, will be duly appreciated. Mr. Scott relates facts and tries to account for them; but I am not certain that I have made it clear to him all I meant by "even texture"—that depends in a great measure on the flow of the molten glass, as well as on the annealing. My gl apparently poured out on a flat surface in *sheet*, and left undisturbed to cool as slo could be done. The grain or texture, as i would therefore be in an *even*, straight line, glass cast in moulds will have to flow in al tions, *wave over wave*, probably *radially*, an not see the possibility of cooling the centre circumference quite evenly. Mr. Wassell's of cutting the disc is rather primitive and t just what I wished to avoid. I feel somewh prised that the many practical glass worker neighbourhood could not, or would not, sug him simpler ones; but I hope we shall receive more information yet on this point. A ready of cutting thick glass into discs would be accep to builders, plumbers, and many others, b amateur mirror grinders; it may, therefor worth ventilating the subject. I had an id trying the following method, unless some who has already tried it will kindly warn me

Having cut the sheet of glass into strips will successively be placed on the wheel, an a good diamond have a clear circular cut t of the intended disc made into them. S transverse cuts outside this will divide the Now a white-hot iron ring will be dropped ju side the marked circle, and, if need be, a d ice inside it, striking sharply the edges at time. I have succeeded this way with glass thick, and hope to succeed with thicker sect have never seen explained how it happens t scarcely visible mark from a diamond or other pointed substance should cause a piece of glas thick to part in two under it. Can crystals b in the same way? Will these cuts not reveal something about the constitution and concate of the molecules? **A. Capla**

[23349.]—A good plan of cutting these wo to have copper cylinders made to size of required. The cylinder should be fixed to a or some machine which would give it a ci motion. Place the glass underneath with cyl on top; set it in motion, and feed with emery water. There will be no risk of breaking, an edges will be left in first-rate condition. The need not be cut into squares first.

W. Pot

PHOTOGRAPHIC SCREW-THREA

[23350.]—One more step has been taken t the methodising and simplifying our English threads. The Photographic Society has a certain standard screws for photographic app and henceforth, photographic lenses will changeable among various cameras, and a source of complexity, annoyance, and expen be eliminated. In order to maintain unifo and give photographers an opportunity of ing their screw tools, Sir Joseph Whitwor Co. have, at the request of the council Society, manufactured a beautiful series gauges, which will be kept at the office Society as reference standards. The fol particulars of these gauges will be of inte your readers.

As to thread-form, that of the Whi standard screws has been adopted—i.e., an is triangle of 55° with one-sixth rounded off and another sixth rounded off at bottom of circles touching the sides of the triangles.

As to thread-rate, the special character light brass tubular fittings of the cells and of large lenses renders the engineer rates able, and the following thread-rates have been adopted:—

For 5in., 4in., and 3½in. diameters, 12 threads per inch.

For 3in., 2½in., 2in., and 1½in. diameters, 24 threads per inch.

For stop and accessory screws, four sizes are adopted, 3/16, ¼, 5/16, ⅜in., with thread-rates of 20, 18, and 16 per inch.

The above diameters are in all cases measured to the outside of the perfected thread.

The gauges all carry cylindrical portions giving the diameters to the inside of the perfected thread, and therefore show the extreme sizes to which the internal screws should be bored out before threading.

The gauges are in steel, not hardened, with the centres upon which they were manufactured left intact. They are as follows:—

One large three-step gauge (12 threads per inch) for the three largest screws. Each step gives, 1st, a cylindrical portion which should just slide inside the perfected thread of the internal screw; 2nd, a threaded portion upon which the internal thread should screw solidly up.

One large four-step gauge (24 threads per inch) for the four next screw sizes. Each step gives a cylindrical and threaded portion, as in the larger gauge.

Four small internal gauges for the stop and accessory screws. Each of these gauges has two cylindrical portions giving diameters for inside and outside of thread, and a threaded portion for gauging the perfected screw (16, 18, and 20 threads per inch).

A steel gauge plate, having twelve holes in four ets of three each. The three holes give for each size of these stop screws diameters for top and bottom of thread, as well as gauge for threaded screw.

With the above gauges there is also a tray of seven standard screwing tools, in hardened steel, for originating the 12, 16, 18, 20, and 24 outside threads, and the 12 and 24 internal threads. The whole apparatus is fitted into a mahogany box.

We have heard no more of late as to the progress of the steps being taken by the council of the Amateur Mechanical Society for adopting intelligible and properly defined lathe threads for the use of their members. If ornamental turning is to progress as a scientific amusement, the present complicated and absurd conglomération of screwing tools must be superseded. The Royal Microscopical Society has for a whole generation had the advantage of a standard screw for its objectives; why should the members of the Amateur Mechanical Society not have a standard mandrel-nose for their lathes? Who stops the way? **H. O. M.**

PUMPING BY SUCTION.

[23351.]—I am not quite so sceptical as "D. L." (22303) regarding this paragraph, and should be glad to have P. J. Davies' attention called to it, and let him give us his views upon the matter. I am not one of those who are so ignorant as not to know it is the pressure of the atmosphere that raises the water from the well; but "there are more things in heaven and earth than are dreamt of in our philosophy." **H. C. B.**

[23352.]—Dr. Atkinson *would* certainly have to "bring out a new edition" if he wished to prove the existence of "suction" as a factor in the working of the common pump, for it is plain that the present one does not attempt that feat.

Paragraph 206 (10th edition) shows plainly that Ganot, in common with Deschanel (pp. 211 and 213), uses the term technically, for we have—"The air being thus rarefied, water rises in the pipe until the pressure of the liquid column, together with the tension of the rarefied air which remains in the tube, counterbalances the pressure of the atmosphere on the water of the reservoir."

I suppose "the piece of wood, &c.," requires to be adjusted so as to preserve this rarefication, and certainly not for "suction." There are not "two sides" to the question at all. **Egstow.**

INGROWING TOENAILS — ELECTRIC BELLS—MEDICAL COIL.

[23353.]—Ingrowing (or inverted) toenail may be cured by mechanical means if not too far gone. The object is to raise the corner of the nail out of and over the flesh into which it is growing; this can usually be done by inserting (with the blunt end of a darning needle) a small piece of lint, putting a fresh one in each day, and gradually increasing the size of the plug. I had one cured in this manner by an eminent surgeon, and I have since successfully treated several others.

On page 478, a correspondent indulges in a long grumble at one of my replies (and in an almost equally lengthy signature). Several others have answered the query (57277); but they have not given exactly what was required. "Practice" gives a contrivance to ring the bell while the door is opened, and then to stop. The reply of "Cosmos" leads to the same end.

"Chemicus" asked for a contrivance which should ring for a *certain time* after the door was opened, whether door should remain open or closed, and I doubt whether the 2s. apparatus (which is *not* described by the gentleman with the long signature) is capable of measuring or indicating any time whatever, and I don't find the required contrivance in any list which I have. That is all I have to say about it.

A very good medical coil can be made on a bobbin about 3in. by 1¼in. For the core ¼in. iron rod, brass tube for regulator, three layers No. 26 silk-covered wire, and 12 layers No. 36 for secondary. Wind and connect the primary as usual; but join the secondary to it, and take the shock through both wires. A bichromate cell, with about 2 square inches of zinc, will give more power than "J. E. A." can possibly require. **Os.**

[23354.]—Whatever else "One Who Suffers" may do, do also this: bathe the foot in water comfortably warm, to soften the nail and the flesh also; then wipe very dry, and at once insert a thread of fine worsted under the corner of the nail, drawing the thread as far in upon the "quick" as can be done without causing very much pain—there must be a little, but it will lessen daily—cut off the ends to within ½in. of the toe, lest the worsted should get dragged away, and draw it more and more under nail as it grows away from the flesh. This is a speedy and most effectual cure. **H. O'B.**

BREAD ADULTERATION — COPPER SULPHO-CYANIDE — EXTRACTING ALCOHOL FROM OIL.

[23355.]—"Bread adulteration" by potatoes (query 52679, p. 416) would have to be very considerable to be objectionable. In my opinion, the use of a moderate proportion of potatoes in bread-making is just as legitimate an addition as that of salt, yeast, or water. A very large proportion of potatoes might be regarded as a true adulteration, but probably such an addition would prevent the rising, owing to the deficiency of potatoes in gluten. The detection of potatoes is best effected by the microscope, but is very difficult, owing to the change produced in the starch-corpuscles by the heating to which they have been subjected; 40 per cent. of water in bread is not an excessive proportion. I am not aware that any salts are used in weighting bread with water. I have found notable quantities of plaster of paris in certain tea-cakes of the muffin tribe, and in oat-cake.

"Copper sulpho-cyanide" (query 52680, p. 416) is of two colours. On mixing strong solutions of cupric sulphate and ammonium sulpho-cyanide, a black precipitate of cupric sulpho-cyanide $Cu''(CNS)_2$ is thrown down. This gradually changes to the more insoluble and stable white cuprous sulpho-cyanide $Cu'_2(CNS_2)$. Probably the reason why the solution of potassium sulpho-cyanide failed to give a precipitate, was that it happened to be weaker than that of the ammonium salt. On adding to the mixture a few drops of dilute acid and some sodium sulphite, white cuprous sulphocyanide will doubtless be thrown down.

"Extracting alcohol from oil" (query 52795) is, of course, impossible in ordinary cases. The only instance in which alcohol is met with as a constituent of oils, is when it has been purposely added to certain essential oils for purposes of adulteration. On adding a considerable pooportion of water and shaking, the alcohol is more or less perfectly removed. But oils liable to sophistication with alcohol are not fit for use as lubricants. Fancy using oil of bergamot, oil of anise, or otto of roses for lubricating machinery.

Sheffield, Feb. 9. **Alfred H. Allen.**

CALCULATIONS IN MECHANICS.

[22356.]—Some of "ours" may have noticed the complaint of the Science and Art Department examiner in "Applied Mechanics and Steam," that too many numerical questions are solved entirely by means of formulæ, and without the least reference to "first principles." Without doubt much of this is true; but I cannot help thinking that between the textbooks and practical questions there is a great gulf fixed.

If you, Sir, could find space, and some of your excellent correspondents time, for a few good letters on calculation of strains, &c., such as not to include the "calculus," I am sure they would be greatly appreciated by a large circle of readers.

Many of your readers must be extremely grateful for Mr. Marshall's articles on "Linkages." Cannot someone help us? **Egstow.**

A Brussels correspondent of the *Times* says it is seriously proposed at Antwerp to bring there during the Universal Exhibition in 1885 the *Great Eastern* as a floating restaurant and hotel.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[51631.]—**Transmission of Sound.**—The replies in number 966, to this query, and in number 964, are unsatisfactory. W. J. Lancaster states that the velocity of transmission in iron is 17 times greater than in air; therefore, iron transmitting low E does so by means of waves of iron measuring 476ft! What is this 476ft. the measure of? and what is the amplitude of these waves of iron? Stone's book, referred to by Mr. Grey, is inaccessible to me.—L. F. H., Queensland.

[52282.]—**Screw Press.**—Many thanks to A. Sugden for his reply to my query. The articles I make are clay pots, and for the larger size the stamp presses the clay 2½in. into a mould. To get the pot out of the mould, it is necessary that the stamp should be lifted 5in. As to the power required, I can only state that it can be worked by a lad of 16 years of age; but he takes a longer time than a man. The pressure is exerted through a distance of 2½in., the last turn of the screw requiring the greatest pressure. I should be glad to know whether I could, by some different adaptation of the screw, make a larger quantity of pots in the time.—J. B. T.

[52302.]—**Cheap Food.**—May I be permitted to reopen and answer some remarks on this question; press of work has kept me from answering them until now. Whole wheat is a very valuable food: its composition varies according to the place where grown; but we can give an average composition thus:—Water 15 p.c., carbonaceous matter 68 p.c., nitrogenous mattter 15 p.c., mineral matter 2 p.c. Thus, we see that it contains a large amount of carbonaceous material (for force and heat giving) and a good supply of nitrogen (for tissue repairing), and plenty of mineral matter (for bone making). It can be cooked very simply. Stewed wheat is thus made:—Soak your uncrushed wheat for a night in water, next day stew for four hours, and it is ready for eating. It can be eaten plain or with stewed prunes, raisins, or jam. Frumenty is the stewed wheat made into a porridge, with flour and a little spice, eaten with milk and sugar. Savoury wheat is made by stewing an onion with the wheat, then chopping the onion fine when it is cooked, return it to the pan (the onion flavour thus gets thoroughly into the wheat); lastly, add brown sauce, stew a few minutes longer, and serve up. This is eaten with potatoes and greens. and makes a good imitation of roast goose. The brown sauce comes in very useful for many dishes, as it acts as a condiment, so I will give the mode of preparing it. *Brown Sauce.*—Brown two ounces of butter or oil in a frying pan, add a dessertspoonful of flour, and stir till dark brown, then add seasoning and thin with hot water to the consistency of gravy. Pour into a gravy boat. Powdered herbs may be added to improve the sauce, and especially sage when using it for savoury wheat. *Savoury Rice* is prepared in the same way, and is also a cheap and nourishing food. Let readers try these dishes, and I will promise them an agreeable surprise. A word about the Esquimaux. These live on fish and flesh from necessity. They eat as much as 8lb. of flesh meat or 12lb. of fish at a meal, says Dr. John Rae, and a friend who lived amongst them 20 years tells me that they usually die from 35 to 45 of scrofula, the women living about 10 years more. He knew of only two men living to be 70. The Esquimaux eat the green contents of the reindeer's stomach, and in spring eat scurvy grass, wild turnips, wild vetch, wild oats, wild rice, sorrel, docks, &c. In autumn they eat wild prunes, blackberries, blueberries, crowberries, cranberries, &c. The women who gather these berries eat more of them than the men, and as my friend says, live longer in consequence, whilst the two men who lived to be near 70, lived as much as possible on these green stuffs and fruits. The Hudson's Bay Company allowed their men 8lb. of flesh daily, or 12lb. of fish, and no flour or anything else. Some were allowed 1lb. of flour and only 4lb. of flesh, showing 1lb. of flour to be equal to 4lb. of flesh, whilst some few were allowed daily 2lb. of Indian corn and ¼lb. of fat bacon. Substitute oil or butter for the bacon and these were vegetarians. The reindeer gets no animal food, yet it subsists well in these regions. These facts will, I hope, set at rest the Esquimaux difficulty. —T. R. Allinson, L.R.C.P.

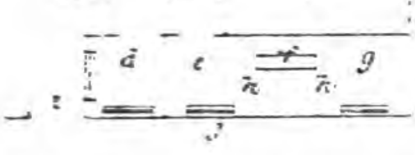
[52370.]—**Dynamo (U.Q.)**—I do not know of any rule; it is a matter for experiment. The E.M.F. produced in a coil of given resistance would vary with the size of coil, strength of field, speed of rotation, and several other factors; so you see how difficult it would be to form a rule. If you want a quantity current, put No. 16 on armature; if E.M.F., put No. 20. These sizes would do for a small machine. Of course with a larger machine you would get the same E.M.F. with less resistance.—W. H. F., Coventry.

[illegible]—**Gramme Armature (U.Q.)**—For a moderately strong field, about one-third of an inch; a very strong half inch. Get some thin linen and dip it in melted paraffin wax, wrap round ring while hot, and smoothe with hand; wind wire on this, and shellac each layer.—W. H. E., Coventry.

[52588.]—**Boring Holes in Glass.**—E. Holmes seems, like others, to have been troubled with the glass cracking in drilling a hole through it. To avoid this, the back of the glass should be sealing-waxed over, or a piece of stout paper, or something of the kind, glued on: the glass will not then crack. It is best to bore from both sides, so as to meet in the middle.—Edward Thos. Scott.

[52590.]—**Faulty Dynamo.**—A machine like yours would be rather difficult to wind so as to generate enough E.M.F. to light a 20c.p. lamp, unless you could get one with a very low resistance, about [illegible] ohms. If you will consider the conditions of machine when running you will see how this result is arrived at. The resistance of your F.M. is [illegible] ohms, and the resistance of A. ·5 ohm, and the external resistance best suited will be 2 ohms, very different to the resistance of a 20c.p. lamp. The machine ought to light four 10c.p. lamps in parallel arc. Re-winding F.M.'s as you suggest would not compensate for the trouble.—W. H. E., Coventry.

[illegible]—**Photometer. — Dark Room.** — *a* weighing-machine, *b* w.c., *c* photo room, *d* gatekeeper's lodge, *e* manager's room, *f* counter, *g*



office, [illegible] wooden partitions, [illegible] entrance, [illegible] frontage. Black your room with lampblack mixed with size and water.—[illegible] Assist. Eng., Gas Works, [illegible].

[illegible]—**Thimbles.**—If by thimbles the querist means the fingerstalls of the [illegible], they are stamped in the machine out of discs of thin sheet metal, passing through five or six different shaped dies, each more nearly approaching the finished shape, the metal being annealed between each operation.—Nun Dor.

[illegible]—**Rapid Lens Shutter.**—If this querist were a little more reasonable in his wants, he might find them satisfied in back volumes. Several such shutters have been described in recent numbers.—[illegible]

[illegible]—**Asbestos.**—If this is powder, it might be worked up into packing for engines or lining [illegible] [illegible] the [illegible] with which it is to be mixed will depend to some extent on the nature of the work to be done.—Nun Dor.

[illegible]—**Variations of Draught.**—You want an anemometer, which is a little fan in a cylinder; [illegible] will go to register the number of revolutions. [illegible] a good many careful experiments [illegible] will be able to form fairly accurate [illegible] [illegible] it would be better to have a [illegible] the [illegible] [illegible] to take the rate of travel of the gases [illegible]. If you can understand mathematics, see the chapter on "Chimney Draught" in [illegible] "Boiler and Factory Chimneys," published by Lockwood and Co.—Nun Dor.

[illegible]—**Working a Pump.**—The querist might try [illegible] windmill to work his pump with the [illegible] [illegible] intelligent village carpenter and the blacksmith. [illegible] that would not be sufficiently [illegible] [illegible] the wind does not come to [illegible] [illegible] might have a [illegible] engine [illegible] [illegible] might be induced to work [illegible] and would probably pump [illegible] [illegible] [illegible] If the querist [illegible] [illegible] [illegible] might be able to [illegible] [illegible] [illegible] [illegible] of well and the [illegible]

[illegible] in reference to what [illegible] [illegible] [illegible] I have [illegible]

[illegible] Bronze.—The Bronze [illegible] [illegible] bronze powder of the [illegible]

[illegible] —An answer to the [illegible]

query involves an explanation of the whole theory of colour. How far apart does Mr. Harcourt consider the "extreme limits of the spectrum"?—G. P.

[52635.]—**Singular Convulsions in a Child.** Only a medical man could give any definite opinion, and that only after examination. There is no special cause for alarm in the symptoms described, which may be due to worms.—F. M.

[52638.]—**Cement.**—Any dampproof glue, or good glue with a dose of vinegar.—T. J. M.

[52644.]—**Rusty Turpentine Tank.**—The cause is oxidation; its effect nil, except as to colour; the remedy, galvanising or tinning the tank.—S. R.

[52647.]—**Drainage.**—If the Local Board have control of a sewer which becomes blocked, and in consequence damages your property, you have a remedy against them. If they are sensible men, and their clerk does not want a case, they will appoint some of their number to assess the damage, and will then pay compensation.—Nun. Dor.

[52648.]—**Model Locomotive.**—"Amateur" will find the information he requires in back numbers (see, for instance, the Index to Vol. XXXII.), except that it is doubtful whether a pressure of 120lb. has been calculated for.—Essar.

[52649.]—**Varicose Veins.**—I have several times cured myself of this distressing complaint by taking care that everything about the foot and leg is quite loose, and, indeed, never suffer from it while nothing tight is worn. Let "Poor Sufferer" abjure boots and "elastics" of every description, and wear low Oxford shoes tied for walking as loosely as possible with ribbon, and when at home let them be untied, and very soon he will find himself comfortable. Socks must be worn (not stockings), and they must be very loose about the ankle. My last attack of varicose veins was brought on by wearing a pair of tight machine-made socks. A return to their old loosely-fitting predecessors soon cured me. It is singular that doctors (not having "like cures like" on the brain) should attempt to cure by tight clothing a complaint that is brought on by tight clothing.—K.

[52652.]—**Regenerative Burners.**—It has been frequently stated that the gas should be rendered as hot as possible as well as the air. See the illustrations of regenerative burners given in back numbers.—Nun. Dor.

[52672.]—**Sleeping with Aged Persons.**—Yes: I have always understood that it is very unhealthy, and something more. I knew a young lady who went as companion to an old person, and slept with her for a time, but she became quite ill: but recovered as soon as the doctor had her sleep alone, who said it was a very bad thing.—Edward Thos. Scott.

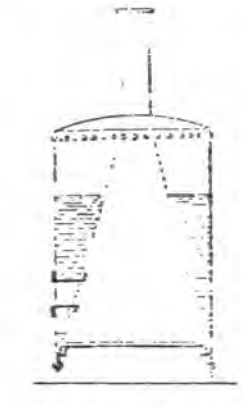
[52687.]—**Florida.**—"F." asks some questions concerning Florida (which I cannot answer), but at the bottom of his letter he asks for "advice about other States." I cannot ask the Editor to give me his space in which to restate the advantages West Dakota offers to the emigrant: but if "F." or any other readers of the "E. M." who are interested, will write to me, inclosing a penny stamp to recoup me for postage, I will send them some literature that will give a deal of valuable information. I am not interested in any railroad scheme, nor do I own enough Dakota soil to induce me to delude my fellow-countrymen.—R. M. Tuttle. Mandan, Dakota, U.S.A.

[52755.]—**Bath Heater.**—I am obliged to Mr. Fletcher and Mr. Bousfield for their replies: but, as yet, no practical information is forthcoming as to how the temperature of 40 gallons of water can be raised to [illegible], for a warm bath, in less time than [illegible] hour. Neither my supply of gas nor water is deficient, as is suggested: and "An Old Subscriber's" remarks on this subject as to the necessity for having a [illegible]in. service-pipe with a 120-light meter, to obtain the results of Mr. Bousfield, show the utter inutility of adopting any such arrangement for a small private bath-room.—H. H.

[illegible]—**Steam Launch.**—Would Thomas Thompson mind putting the size, &c., of engine in the "E. M." for the sake of other readers?—[illegible]

[illegible]—**Knocking inside Cylinder.**—The "knock" may arise from a variety of causes—e.g., piston loose on rod; piston rod touching bottom of cylinder; no compression at bottom; &c., &c. It is impossible to assign a cause to it without a thorough examination, but if "Engineer Jack" will advertise his address, I shall be happy to render him all the assistance I can in getting rid of the noise. The result of leaky air-pump valves and drawing air through the gland is defective vacuum.—Labor Omnia Vincit.

[illegible]—**Boiler for Model Engine.**—The boiler of which I inclose a rough sketch is made as follows:—Body of sheet brass or copper [illegible] thick, [illegible]in. diam., [illegible]in. high, a dome-shaped top flanged down ⅜in. all round, to fit tightly inside [illegible] of body, which must be riveted up the seam: [illegible] top must also be riveted in, after which the [illegible] and rivet-heads should be thoroughly solder-[illegible] inside. The firebox is made of copper and is conical in shape, it should be brazed up the seam, and be of such diameter that it fits the boiler tightly at bottom, and it should taper to 1¼in. at top. The funnel is of copper brazed, 1⅛in. diam, and about 5in. high. The firebox is riveted to the boiler round the bottom. The top of boiler is flanged up in the centre round the hole for the top of firebox about ¼in., the top [illegible]



firebox is then flanged down outwardly over the [illegible] of boiler, and well planished down all round; this makes a very strong joint. The firedoor ring is put in in a somewhat similar manner, as will be seen from the sketch. I have made several boilers on the above plan of different sizes, and have always found them answer capitally. They burn coal splendidly, and get up plenty of steam. I am unable to say what the cost of making one would be, as I make mine myself, but they require careful workmanship.—C. E. B.

[52823.]—**Electric Lamp.**—I know of no lamp suited to the purpose unless you have power always available equal to, at all events, 20 Bunsens or bichromates. These, with a 16-candle Swan lamp, will serve.—Sigma.

[52833.]—**Water Heater.**—I am not a "legal" man: but if I may offer any advice on this point, I would say, heat the feed water by all means if you want to save coal. There are various kinds of water heaters made where the steam is passed through a coil or a number of brass or copper tubes, and are arranged so that the interior can be easily cleaned. By using a heater and frequently removing the mud from inside, there will be less deposit in boiler. I could lend you a drawing of one I have in use if you advertise your address.—Labor Omnia Vincit.

[52840.]—**Core Box for Globe Valve.**—To "J. H."—Thanks for your offer of assistance. The description of the valve you give is exactly what I mean. They are made largely in brass for connections for malleable iron pipe, and what set me inquiring was seeing some made by Cooper Jones and Cadbury, of Philadelphia. How they are cored I cannot understand very well. I am a patternmaker, so that I can easily do the work if I know what is wanted.—Quebquen.

[52845.]—**Law respecting Churchyards.**—"F. R. C." cannot do better than get "The Book of Church Law," by the Rev. J. H. Blunt, M.A., published by Rivingtons, price 7s. 6d. The body cannot be removed without a "faculty."—Curate.

[52855.]—**Vibration Number of Whistle.**—An open organ-pipe or whistle 2ft. long, corresponds in pitch to the note of Middle C of the piano. I think "Student" must have made some mistake whilst comparing the pitches of his whistle and middle C of the piano. His calculation is correctly worked out.—Cymro.

[52863.]—**Removing Caps from Green's Economiser.**—Saturate the caps with petroleum and you will have no difficulty in removing them. All corroded joints and bolts should be so treated.—J. F. W.

[52867.]—**Feed Pump.**—Respecting "Fire's" reply to the above query, in case the stroke of ram is not 1ft., how will he work it out? As a case in point, what would be delivery of a ram 4in. dia., 8in. stroke, 50 strokes per minute? Has "Fire" noticed my query re Green's Economiser, and can he assist me?—Simplex.

[illegible]—**Electro-motor.**—No single cell of any kind would do the required work, and certainly not a Daniell. All the Leclanché forms are useless for such work, and it would require at least five bichromates.—Sigma.

[illegible]—**Battery.**—To "Kosmos."—In reply, 1. Yes. 2. I was not aware that the chloride of zinc or am. battery could be strictly termed a bichromate, or I should not have expected my battery to last so long. My bichom. sol. is saturated + ⅛ muriatic acid; if I added more acid and less solution to outer cell, would it tend to lengthen or shorten the battery's life, or if I add muriatic acid to ch. of am. of porous pot, will that lengthen the useful period? 3. I do not think so. I have found the Leclanché more troublesome in the long run, and I require considerable power, as I work two needle instruments, six bells, and three indicators on the four cells chloride. Your further reply will be esteemed by—R. Hannen.

[52878.]—**Analysis of Coal-Tar.**—There is not, I believe, any book treating specially on this analysis; but valuable information respecting coal-tar products may be obtained on reference to "Commercial Organic Analysis," A. H. Allen; there is also a book by Lunge, which may possibly be of use to the querist. Coal-tar contains many exceedingly complex bodies, and it is not to be wondered at that many yet remain undiscovered, and those capable of estimation being in some cases but approximate.—J. C. Belcher.

[52878.]—**Analysis of Coal-Tar.**—Tar is too complicated a mixture to be subjected to regular chemical analysis. The only reliable method of testing a coal tar (and the one generally used by tar distillers) is to distil a small quantity of it, say, 20 to 30 gallons, in a small still reserved for that purpose. It is thus separated into different parts, which are weighed and then tested separately for the constituents which it is intended to extract from them. Tar contains on an average 0·6 per cent. benzine, 0·4 toluene, 0·5 xylene, and other hydrocarbons of the benzine series—8 to 12 per cent. naphthalene, 5 to 6 per cent. phenol, 0·25 to 0·3 per cent. anthracene. If "Augustus" would tell me which of these bodies chiefly interest him, I shall be glad to explain how and where to look for it.—Organic Chemist.

[52879.]—**Analysis of Oilcake.**—Church's "Laboratory Guide" furnishes the desired information. The process is somewhat lengthy, or I would describe it.—J. C. Belcher.

[52879.]—**Analysis of Oilcake.**—Oilcake is chiefly used as food for cattle. Its analysis ought therefore to show its value as such, as well as the quantity of residual fatty oil contained in it. To make an analysis of oilcake, powder it finely, then heat a weighed quantity to 100 to 110° C. in a drying chest until it assumes constant weight. The loss it sustains represents the water. Introduce a weighed quantity of the dried material into an extracting apparatus, and extract with ether for two to three hours. Drive off the ether and weigh the remaining fatty oil. The residue from the extraction may be carefully dried at 100° C. to get rid of the ether, &c. It may then be tested for nitrogen by the well-known soda-lime process. From the quantity of nitrogen obtained a fair estimate may be made of the quantity of albuminoid (nutritive) matter present in the oilcake.—Organic Chemist.

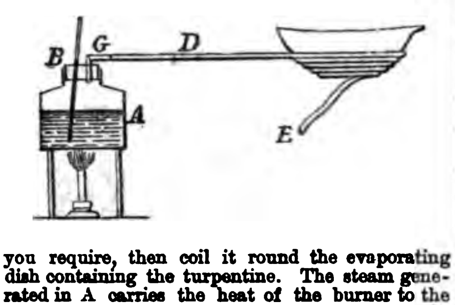
[52884.]—**Engine Query.**—The only way out of your difficulty is to raise the boiler to the engine level. You can reduce the condensation by coating the pipe with a good non-conducting material. Also fit a tap in the steam-pipe, near the engine, which should be opened for a few moments when starting her. I presume the highest point of your boiler is 6ft. below the engine.—J. F. W.

[52885.]—**Ancient Lights.**—My best thanks to "Ditton." Will he kindly give a little more information? I want to know the position of the angle—e.g., a line perpendicular to the plane of the wall containing the "light," being one of the legs of a right-angled triangle, which is also isosceles, forms an angle of 45° with the hypothenuse at that point; but where is the position of the angle situated? Is it at the base of the wall—i.e., on the ground plane or at the window-sill? which latter may be 3ft., 20ft., or possibly 50ft. from the ground, which distance constitutes a vast difference.—Old Ploughman.

[52886.]—**Dynamo.**—Certainly the addition of the iron ends is a most effectual way to destroy the power of the armature to produce currents; they should be gun-metal. I have not time at present to consider whether other causes of failure exist in the proportions, and should say put that right first.—Sigma.

[52892.] — **Polishing Paste.** — The German polishing pomatum you speak of is prepared by grinding together ferric oxide (*caput mortuum*) with tallow, adding a little mirbane to cover the smell of the tallow. The best *caput mortuum* for polishing purposes is obtained by precipitating a solution of ferrous sulphate with oxalic acid, and subsequent ignition of the well-washed crystalline precipitate. This preparation, however, is too expensive for the manufacturers of polishing paste, who use the common article of commerce, or even the still cheaper residue of pyrites obtained in the manufacture of sulphuric acid. — Organic Chemist.

[52900.]—**Water, Steam, or Sand Bath.**—The following plan will probably suit your purposes. Obtain a tin can, A, capable of holding, say, half a gallon of water, and fit it with a good cork carrying safety tube (B) and steam-tube, G, both made of glass. Fill the can half-full with water, and apply heat by means of a powerful Bunsen burner; connect G by means of an indiarubber joint, with an ⅛in. leaden pipe; carry the latter straight as far as you require, then coil it round the evaporating dish containing the turpentine. The steam generated in A carries the heat of the burner to the evaporating dish, and escapes at E, almost entirely condensed. The arrangement may be improved by surrounding the leaden core with some non-conducting material, such as woollen rags, sand, &c. You may also immerse the core into the liquid if there is no fear of an action of the latter on the metal.—Organic Chemist.



[52909.]—**Barlow's Wheel.**—"E. D." will find the action of this a case of "rectilinear repulsion" (Guthrie, p. 240). When a point of the wheel touches the mercury in the trough the circuit is completed, and the point "moves away from the resistance," if I may use such a phrase. If the points be too deep in the trough, I have often found the current unable to overcome the inertia; but even then, on starting the wheel by hand, it will continue turning. The copper disc wheel is only a particular case of the stellar wheel—is, in fact, a stellar wheel with an infinite number of points.—Egstow.

[52914.]—**Dynamo.**—In reply to this query, Mr. Bottone has, on p. 102, "An ammeter (or current measurer) consists essentially of a galvanometer wound with a very large quantity of very fine wire, so that the resistance in the instrument is infinitely greater than the resistance in the dynamo; but such instruments are very misleading. Such an instrument, if used in the main circuit as an ammeter, would indeed be very misleading. All the ammeters that I have ever seen or heard of have a coil of as low resistance as possible; in fact most of them have simply a broad copper band underneath the needle. Mr. Bottone must have been thinking of a voltmeter.—Electro, Manchester.

[52918.]—**Transmitter.**—The lead weights are put on the pieces of wood attached to the carbon cones to act as ballast and keep the cones upright. Sheet flattened out, or a small strip cut from a piece of sheet lead, will do. I used lead wire because I had it at hand; it can be obtained from the seedsmen, as it is used for tying up plants. This microphone works by the difference in the vibrations of the various parts; by making one of the pieces of wood attached to the cones longer than the other, it alters the rate of vibration of that one; the consequence is that the two cones respond to different vibrations, and the articulation is much improved. This microphone, though it only transmits speech when spoken to, transmits every note of a piano played in the room in which it is fixed, and with an unusual freedom from burr. My clear-speaking receiver is both described and illustrated in the Mechanic of the 29th June last. It is patented, and cannot therefore be lawfully used without a license. I hope soon to arrange for the granting of licenses at such a very moderate royalty, as will bring the telephone into general use, and will make it a popular instrument.—H. B. T. Strangways.

[52926.]—**Double-Cell Bichromate Battery.**—I do not know why such a deposit should form if the solution contains free acid; nor do I remember to have ever been troubled with it. There must be impurity or bad arrangements.—Sigma.

[52927.] — **Watchwork.** — Your watch most probably winds up too far, and by so doing takes all power off the train. See to the stopwork, and also see that the chain is the proper size. Take the watch to pieces, try the chain on the fusee without the plates, and when you have filled the groove in the fusee, you should have about fourteen links and the hook left. If the chain be too long, make it the size stated, then try it in the plates, and see that when it is wound up the stop holds it properly; also see that the fusee arbor is free between the plates; put a drop of oil in the barrel with the mainspring, and you will see that your watch will work if all the train, &c., be right.—Hamlet.

[52929.]—**Engine Query.**—If this querist is the same that I replied to on page 394, query 52550, he was there told to have his engines indicated in order to find out the power exerted. Moreover, in the original query the sizes given are very different to those in the last query. Look here, "Engineman." Have those engines indicated, and find the mean average pres. on each piston, and then multiply the area of the cyl. by the average pres., by the speed of piston in feet per minute, and divide by 33,000; the quotient is the h.p. exerted by that engine; and next time you ask a query, be sure the dimensions you send are correct.—Labor Omnia Vincit.

[52932.]—**Delirium Tremens.**—In answer to "Cymru" one may say that pain is never accompanied by pleasing thoughts or visions, save where a person has been suffering martyrdom for a great cause. The disease of delirium tremens is a painful one, attended by great nervous weakness and fear, and the concomitant visions are of a fearful nature. The visions seen in dreams and delirium tremens are allied phenomena. No one, however, would expect a sleeper to see pleasant dreams if a mustard plaster were applied to the top of his head; but he might imagine some fearful thing as, *e.g.*, that he was being scalped by wild Indians, and he would certainly not have pleasant and happy dreams. So likewise the sufferer from delirium tremens builds up frightful images in his disordered brain as the result of its disorder. Nor could one expect him to see anything pleasing under the circumstances, no more than one would expect a child passing some dark and lonely nook, in fear and trembling, would see in the darkness friendly faces instead of hobgoblins. For a discussion of the nature of delirium tremens, I may be allowed to refer "Cymru" to my recent work on "The History and Science of Drunkenness" (London: Simpkin, Marshall and Co.).—William Ackroyd.

[52938.]—**Heating of Journals.**—If "Apprentice" will state whether the shaft is steel or iron, and will apply to Osborne and Co., Limited (see advertisement facing first page of matter), he can be supplied with the requisite composition for his purpose.—A. L.

[52940.]—**Gas Stoves.**—The iron flue is carried only in the parts where it is cool enough to condense the products of combustion, which contain a trace of sulphuric acid. There is no remedy except to use copper or pottery ware tubes in the colder parts of the flue. The stove will probably be hotter than boiling water all over, and there will therefore be no condensation and consequent rust.—T. F.

[52943.]—**Electro-Magnets.**—To prevent the armature sticking, solder a thin piece of copper on the poles of your magnet.—M. Seymour.

[52943.]—**Electro-Magnets.**—"C. B." only wants Nature to alter her system for his convenience. With an armature in actual contact, residuary magnetism is great. The only remedy is to prevent contact. A good plan is to tin the face of the magnet, or deposit copper or silver; but, of course, this rather lowers holding powers, though not the attractive power.—Sigma.

[52943.]—**Electro - Magnets.** — "C. B.'s" magnet is, I should say, not soft enough. If the wire is wound on reels and slipped over the poles, I should advise removing the reels and leaving the iron horseshoe in a clear fire all night. He might, however, first try the effect of sticking one thickness of thin paper over the poles, so that the armature will not actually touch the magnet.—B. H.

[52943.]—**Electro-Magnets.**—The reason the armature adheres to the poles, is that the iron of the magnet or armature is not soft enough, and consequently retains permanently some magnetism. Even if the magnet were composed of the softest iron obtainable, some of the magnetism would still remain for a time, and, in fact, the residual magnetism is never fully eliminated. The armature can be made to release, when the current is stopped, by using a spring to counterbalance the attractive effect of the magnetism.—Electro, Manchester.

[52943.]—**Electro-Magnets.**—Your magnet is not made of sufficiently soft iron. Take off the wire and put the iron into the fire. While it is getting red hot make a nice little hole amongst the cinders in the grate, in which, when red hot, you must bury it. It must be left among the ashes till quite cold, and on no account must it be cooled quickly. You will find this answer perfectly well. Far from injuring the "holding power" of the magnet, it will increase it, for soft iron is always more strongly magnetised by the current than when not annealed.—R. A. R. Bennett.

[52945.] — **Oxidising Copper Wire in Battery.**—The sal-ammoniac forms chloride of copper, which is bright green. You should use iron wire coated with indiarubber, which can be dissolved in naphtha, and well painted on.—M. Seymour.

[52946.]—**Lightening a Wife's Duties.**—Try a small windmill and pump.—M. Seymour.

[52946.]—**Lightening a Wife's Domestic Duties.**—As the required quantity of water only amounts to a bucketful a day, raised to the height of one story, it appears that the simplest plan would be to invest a shilling in a bucket and carry it up full each morning. If the querist can drop on a second-hand beer engine, and fit it up with a pipe leading to the cistern, the water might be pulled up half a pint at a time, if desired, without much trouble.—SIGMA.

[52945.]—**Lightening a Wife's Domestic Duties.**—If "A Reformed Partner" will further reform himself and carry up the 20lb. weight of water which his wife requires daily, he will have a reliable apparatus which will cost nothing, and need no fixing. Little and cheap pumps are to be bought in any quantity; but if no fixtures are allowed, it is hard to see how a satisfactory arrangement could be made. It would certainly be cheaper to pay a penny for having a bucketful carried up than for a lodger to spend, say, 30s or 40s. on a pump.—T. F.

[52948.]—**Banjo.**—(1) Ballantine's "Banjo Tutor," to be obtained at John Alvey Turner's, Crosby Hall, London, E.C., is the best book on the six-stringed banjo (price 1s. 6d.) (2) You can get the proper sized strings of the best quality at Turner's. The first string should be a fine violin E; second, a violin thick E; third, a violin second A; fourth, a violin third D; fifth, a fine silver-covered gut string; and the sixth, a violin E, like the first. (3) The tips of the first and second finger should be nearer the bridge than the tip of the thumb. The further you can get them back from the thumb, the better the tone produced.—H. B. G.

[52948.]—**Banjo.**—(1) In my experience the best banjo tutor for a six-stringed banjo is Ballantine's, which is published by John A. Turner, 33, Bishopsgate-street Within (Crosby Hall), price 1s. 6d. (2) The correct strings are as follows:—The first should be violin first E; second, violin second or thick first E; third, violin second A; fourth, violin third D; fifth, fine silver-covered gut string; sixth, violin E, like first. (3) I always strike notes with the tip of the forefinger, nearer the bridge than the thumb in striking notes with the forefinger and thumb together. I think you will find the banjo tutor I mention the very thing you want.—T. M. COOMS.

[52950.]—**To Violinists.**—The breaking of strings may be caused by the violin being improperly set up, and I would advise querist to get some experienced violinist who would arrange bridge, &c. The finger-nails should also be pared closely. I hardly know what to say about the shortness of little finger. Are you sure you hold the violin rightly? The palm of the hand must not touch the neck of violin. The wrist must be thrown back, bringing the fingers vertically over the strings. Schubert's Violin School, Vol. I., Littolff Ed., shows the position very well.—SPOHR.

[52951.]—**Smith's Forge.**—"Young Country Smith" should make the hole in his tue iron 1in. diameter for bellows 36in. broad, and, if possible, use coke in place of coal, although we find much of the coke made from Staffordshire coal makes much dross and scale, which adheres to the iron when heated to a welding heat. Also let him fix his tue iron to stand 3in. from the wall of his hearth to the nose of tuyeres.—BASSO.

[52952.]—**Loss of Voice.**—Querist should have mentioned his or her sex, as in females loss of voice is often a phase of hysteria. I should advise querist to have the throat examined with the laryngoscope. The condition is very probably due to swelling of the mucous membrane covering the vocal cords, for the relief of which astringents must be applied directly to them. On the other hand, it may be due to paralysis of one or both cords and require constitutional treatment.—M. D.

[52952.]—**Loss of Voice.**—"M. L." must swallow three raw eggs per day to restore the organs of voice to healthy action. I had been speaking in whispers for two weeks when "A Wise Woman" advised me as above, and five eggs effected a cure, verifying the truth of the nursery rhyme about the woman sucking "birds' eggs to make her voice clear." The more newly-laid you can obtain them the more curative and the sweeter they will be. Break the yolk, but it need not be beaten up. No condiment is required.—H. O'B.

[52954.]—**Hand Water Tap.**—Cannot Arnold Waterfield do as he requires by using the end of a rubber tube as the jet, and turning off the water by pinching the tube?—T. F.

[52954.]—**Hand Water Tap.**—For such a purpose nothing is better than a piece of soft rubber pipe held between finger and thumb. If more elaborate plan is desired, place the pipe between the two parts of a jointed lever, like a pair of nut-crackers, with a rack at the end, under which the movable arm can be slipped when not in action.—SIGMA.

[52958.]—**Ancient Lights.**—The "45° line of light" is [illegible], and if the new building is built so as to make [illegible] angle with the "ancient light" an injunction may still be granted if a material diminution of light be proved. The angle of 45° is measured from the bottom edge of the "ancient light," so that if the distance between it and the new building be as great as the height of the new building above the bottom edge of the "ancient light," then "the 45° line of light" is preserved.—JOHN P. OSBORNE, Birmingham.

[52959.]—**Beer in Scratch-brushing.**—If "W. H. H." means sour beer, a little vinegar and treacle should give the same result.—T. F.

[52959.]—**Beer in Scratch-brushing.**—Use a mixture of the following: ½ pint of oatmeal boiled in two quarts of water, strain, and then add ½ pint of strong vinegar.—M. SEYMOUR.

[52960.]—**Silk Flaps on Plate Machine.**—You should use lard, not olive oil; only one thickness of silk.—M. SEYMOUR.

[52960.]—**Plate Machine.**—Why use oil? Oiled silk is certainly recommended outside the plain black silk; but oiled silk is a well-known dry preparation—not silk wetted with oil. You can get it at any chemist's.—SIGMA.

[52960.]—**Plate Machine, Silk Flaps.**—The silk flaps are stitched on to the rubber. Only one layer of silk is used. Neither the rubber nor flaps should have any oil whatever applied to them. What "W. H. H." has mistaken for the real silk flaps are simply pieces of oil silk, sometimes put on to protect the real flaps, which are underneath.—ELECTRO, Manchester.

[52961.]—**Butterflies.**—Dip the whole insect into chloroform, and leave it for a few minutes to get thoroughly soaked. When taken out it will be found to be "relaxed." Set it while soaking wet. It will dry in a few minutes, and remain set as you put it. This will answer well if properly done. The effect of the chloroform on the colours is alarming, but they all come back as brightly as before when dry. "Lu" had better practise on a few common butterflies first.—R. A. R. BENNETT.

[52961.]—**Butterflies.**—A safe way of relaxing these insects is to float them on a piece of sheet cork in a basin of water, over which a wet cloth is to be stretched, making the interior as nearly air-tight as possible. It is a good plan to place a slip of wood or cardboard over the cork, thus preventing the water from soaking through to the insects, and care must be taken that the cloth is not too wet, or drops will collect and fall upon the butterflies. Many small species will, by this means, be relaxed in twenty-four hours, larger ones taking longer, in proportion to their size. Very delicate handling must be exercised. After relaxing, they will require fixing upon proper setting-boards, and much of their value depends upon the success of this process. If "Lu" likes to send me seven specimens, I shall be pleased to return him six properly relaxed and set, keeping the seventh for my pains.—MARTIN J. HARDING, Old Bank, Shrewsbury.

[52961.]—**Butterflies.**—For relaxing insects that have once dried there is no rapid method of any use. The following is the very simple mode adopted by myself, and I believe also by most entomologists, who frequently have more specimens than they can properly set in the summer, and who allow them to dry till they can give them more careful attention in the slack season of winter. An ordinary soup plate is filled with sand; this is made thoroughly wet, surplus water being drained off. A thin sheet of cork, on to which the insects to be relaxed are pinned, is laid on this wet sand, and a finger glass reversed over them. Some insects will take as much as three or four days to become sufficiently soft to set, and must not be taken off the setting boards till thoroughly dry, requiring another two or three days for that purpose. Reset insects have, however, one great peculiarity—namely, a tendency to spring back after a time to the position in which they originally dried. To avoid this when the insect is satisfactorily set, it should be removed from the board, and just touched underneath where the wings unite with the body, with a cement made of shellac dissolved in spirits. The point of a knitting needle is about the most convenient thing with which to apply the cement. After this is done, the insect should be replaced on a setting board with a very wide groove to prevent the cement touching the board, and be strapped down for another day till the cement is quite hard. For relaxing, ordinary winebottle corks, stuck end in to the damp sand, answer admirably, and take just one insect each.—A. LLOYD.

[52965.]—**Regulator for Shocking Coil.**—"Mungo" can regulate his shocking coil by having a brass or copper tube to slide over the iron core. The greater the length of core inclosed by the tube, the less will be the effect in the regulator. He may also use a water regulator consisting of a glass tube, with a brass cap each end, and a sliding brass rod through one cap. The tube is filled with water, and the terminals of secondary connected to the caps. By varying of rod immersed in the liquid, the current may be regulated.—ELECTRO, Manchester.

[52967.]—**Hydrogen Peroxide.**—This article is a commercial article, and can be bought in 10 or 12 volume solutions, cheaply, and therefore your latter queries do not need answering. It is a powerful oxidising agent, and the best that can be used where other ingredients are objectionable, such as manganese and lime.—GEO. G. BLACKWELL.

[52968.]—**Slide Valves.**—"Formula" will find the following in Ainsley's "Engineer's Manual" and a great deal more information that would be useful to him: L = lap steam side = $1\frac{1}{2}$in.; l = lap exhaust side = $\frac{1}{4}$in.; D = lead = $\frac{1}{8}$in. The $(L + D) - l$. Thus, distance from mid position to where open for lead = $1\frac{1}{2} + \frac{1}{8} = 1\frac{5}{8}$; exhaust port open = $1\frac{5}{8} - \frac{1}{4} = 1\frac{3}{8}$in.—W. ROU[illegible].

[52969.]—**Chloride Battery.**—The proper charge for "chloride" battery is:—Inner cell, $1\frac{1}{2}$oz. chloride of zinc; outer cell, saturated solution of potassic bichromate, 2 parts; hydrochloric acid, 1 part. A little mercury at the bottom of the inner cell.—R. A. R. BENNETT.

[52971.]—**Antimonial Lead.**—Dissolve your antimony in nitric acid, then add excess of ammonia, and afterwards hydrosulphide of ammonium, which has had a small quantity of flowers of sulphur added. The precipitate digested at a moderate heat is gathered upon a filter, washed with water containing a little hydrosulphide of ammonia. The filtered liquid containing the antimony should have a little acetic acid added; the sulphide of antimony precipitates, and is gathered, washed, dried, and weighed.—M. SEYMOUR.

[52972.]—**Turning Stone.**—In answer to Geordy Black, he does not give the size of pillars, so that it is impossible to say whether they will require iron centres. If they are not very long, and thick enough to bear turning, they will not require them; but, perhaps he means simply centres for fixing on lathe-nozzle and poppet. If so, they will require them. Tools used for turning iron are not suitable. A bar of steel 2ft. or 2ft. 6in. long drawn out to a sharp point much longer than point used for metal will be the best tool, and either turn dry or use a little water. As to polish, I never heard of such a thing as polishing sandstone. He might varnish them, but that would not be a real polish. After turning as fine as possible, grind with sand and water, and, if wanted fine, finish with fine emery and water.—W. POTTS.

[52973.]—**Sharpening Circular Cutters.**—I think what is alluded to in your inquiry is the process of sharpening the above by emery wheels if the teeth on the cutter are not too fine in pitch. Circular saws, cutters, and a variety of machine knives are ground by these stones, and, with care, are quite equal to a file-finished job.—WILLIAMS.

[52973.]—**Sharpening Circular Cutter.**—I have used for years the small corundum wheels made for dentists, run at a slow speed, with plenty of water, and these were adopted by the L. and N.W.R. at Crewe at my suggestion. I believe now that small emery wheels can be got made to special sections for the purpose. These can be run so as to cut quicker than the corundum wheels.—T. F.

[52976.]—**Bleaching Horsehair.**—You will never get this white without destroying it; but first well boil it, and while still hot dip it in hydric peroxide.—M. SEYMOUR.

[52978.]—**Dynamo Machine.**—I suppose the compound Siemens armature means the usual Siemens dynamo, of which I gave a diagram of the winding in a recent number. What "J. P. M." asks me for is simply to furnish an essay on the subject, and give up a couple of days' work to the matter. He must content himself with such information as Mr. Bottone is giving, or as may be found in various books. It is not possible to furnish fresh particulars to each separate person who wants to make a dynamo.—SIGMA.

[52979.]—**Railway Keys.**—I know a little about the M.R. system with keys placed inside, and have had cause to complain about them some years ago on account of the wheel-flanges running on them, which causes them to be quite sharp. When tyres get run down, the flanges get deeper, and so run on the chairs. This is, I have no doubt, the reason for changing them to the outside, so the wheels will run longer without turning up.—LOCO.

[52980.]—**Crescent Moon.**—In reference to Arthur Mee's query on this subject, it is stated in the *Intellectual Observer*, Vol. VII. p. 240, that an observer at Runcorn observed the moon on [illegible] February, 1864, when it was little more than [illegible] hours old. On January 28th, 1865, Mr. D. J. Freeman saw it at Mentone when it was 32 hours old, and was informed by an inhabitant of the place that some years previously he saw the thin crescent of the *old* moon above the horizon before sunrise, and on the evening of the same day saw the thin crescent of the *new* moon soon after sunset. Mädler saw it 18 hours before conjunction on October 1st, 1834.—THOS. GWYN ELGER.

[52985.]—**Legal.**—In reply to G. Russell Pri[illegible]ham, the Act of Parliament compelling a father, grandfather, mother, grandmother, or child of a pauper to support him, is the 43 Eliz. c. 2, s. 7.—B. H.

ANSWERED QUERIES.

umbers and titles of queries which remain unan- 'or five weeks are inserted in this list, and if still red are repeated four weeks afterwards. We trust ers will look over the list and send what information for the benefit of their fellow contributors.

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our last, "W. H. E." has replied to 52370, 52375.

Warp Winding, p. 313.
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Holding Links without String, 313.
Memorial to Home Secretary, 313.
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Incandescent, 395.
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Paper Scenes, 395.
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Siemens' Dynamo, 396.
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Wimshurst's Influence Machine, 396.
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Gumming Machine, 396.
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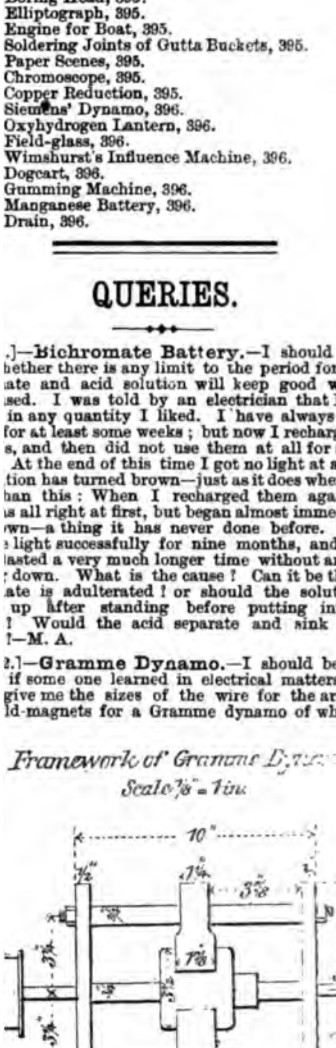
QUERIES.

.]—**Bichromate Battery.**—I should like to hether there is any limit to the period for which ate and acid solution will keep good without sed. I was told by an electrician that I could in any quantity I liked. I have always found for at least some weeks; but now I recharged my s, and then did not use them at all for several At the end of this time I got no light at all, and tion has turned brown—just as it does when used. han this: When I recharged them again, the s all right at first, but began almost immediately wn—a thing it has never done before. I have light successfully for nine months, and it has lasted a very much longer time without any sign down. What is the cause? Can it be that the ate is adulterated? or should the solution be up after standing before putting into the ? Would the acid separate and sink to the ?—M. A.

2.]—**Gramme Dynamo.**—I should be much if some one learned in electrical matters would give me the sizes of the wire for the armature ld-magnets for a Gramme dynamo of which the

Framework of Gramme Dynamo.
Scale 7/8" = 1in.



Section.

gives the principal dimensions of the framework y made. What should be the relative resistances ring and field-magnets, and what would be the ble lighting power, and the amount of h.p. ed in driving it? Into how many segments would est to divide the ring?—D'Elgo.

83.] — **Melting Tallow.**—Would "London " kindly explain how rough tallow is melted by and sulphuric acid? I have tried, but find tha ter, fat, and acid combine into a kind of soup, from which the fat will not separate. The steam was blown in, and the material was damaged hams. The débris fell to the bottom, taking the fat with it. A chemist told me it was albumen caused the bother. What is the remedy?—Country Workman.

[52984.]—**Chilled Castings.**—I have a number of cast-iron rims of wheels to make, that are required to be chilled on the outside from 5-16in. to ⅜in. deep. They are about 2in. wide. I can only get a chill on them of about ⅛in. I should be glad if any of our correspondents could help me as to what kind of iron I should use, &c.? There are no arms or centres in them to interfere with the contraction.—One in the Trade.

[52985.]—**New Synchronised Clock and Time Signals at the British Horological Institute, Soho.**—Can our esteemed friend, Mr. Baldwin, or others, oblige us with a description, with sketch, of the above? Also, if we can make same to exhibit in shop window?—Several Shopkeepers.

[52986.]—**Lightning Conductors.**—Can "Sigma," Mr. W. J. Lancaster, or any of "ours," give me any information as to lightning conductors as erected upon Houses of Parliament? By whom erected? What kind, and how long since they were tested?—Conductor.

[52987.]—**Nickel Plating.**—I am fixing up a small apparatus for nickel-plating. Will some of your contributors kindly give the composition of nickel solution? —E. W. N.

[52988.]—**Paint Manufacture.**—Can any of your readers furnish information as to the plant necessary for this manufacture? Possibly some one may be able to give reference to some book treating upon the subject. What is considered to be the best m terial at the present day for coating the bottoms of iron vessels?—Eothen.

[52989.]—**Lead-lined Outer Vessel for Battery.** —Large glass vessels being too expensive and too breakable, I intend using wooden rectangular boxes 10in. by 5in. by 9in. deep, which I cannot make watertight, and line them with sheet lead ¾mm. thick (corresponding, I suppose, to, say, No. 21—22 B.W.G.). I have vainly tried to solder the plates together at the joints—scraping first the lead, then rubbing it with a tallow candle, and pouring molten lead on the joints. The lead does not stick, and at some places melts the sheet away. What should I do?—Belgian.

[52990.]—**Siemens I Armature.**—Will any one give the correct section of this piece? I intend getting one cast in malleable iron 5¼in. long and 1½in. diameter. Are these proportions right?—Belgian.

[52991.]—**Metal Turning.**—Will any one advise a good practical book upon lathework for an amateur's use?—making the tools, grinding them, &c. "J. H." would certainly oblige a quantity of amateurs by sending letters upon this subject.—Belgian.

[52992.]—**Slide-rest to turn Cones.**—I have a 5in. screw-cutting lathe, and want to graduate my rest to all useful degrees. I wish above all to know how to ascertain when the short side-sliding motion is parallel to the centre line?—Belgian.

[52993.]—**1 H.P. Boiler.**—I want to make one as compact as possible with, say, 12 locomotive copper tubes inside. An engine is all very well; but boilers are seldom advertised, and if an estimate be asked, prices are very little different from that of the engine itself, if not higher.—Belgian.

[52994.]—**To S. R. Bottone.**—Would you kindly give an estimate of first cost for making a motor, and hourly expense for working it, to drive properly a 5in. back-geared lathe, with a battery which I leave to your judgment to advise.—Belgian.

[52995.]—**Pressure of Water.**—Can any of our readers tell me—Is the pressure of the water at the bottom of the sea much greater than at the surface? If so, how can it be calculated without algebra? Or, putting it simply, what would be the pressure on the sides of an air-bladder at different depths?—Practice.

[52996.]—**Brick-Glaze.**—Is it possible to get a white glaze on common bricks by any means? Could I manage any other colour? Perhaps some of our "chemistry" friends will suggest, and I should be glad to experiment, and be thankful. Is there any book on the subject?—Brickmaker.

[52997.]—**Legal.**—A. leaves by will value in shares, &c., to be divided in certain proportions among his brothers at the death of his wife. In the case of one brother, he dies about the same time as the widow, and before the money can be distributed. His wife and children in direct descent are all dead. He makes a will some time before his death in favour of the widow of one of his sons, and certain sums to his grandchildren. He, however, becomes bankrupt just previous to his death, and when the money left him by his brother comes to be distributed, his will is set aside, and his grandchildren are called upon to administer with the will attached to the letters. Two of the grandchildren (known to be abroad) cannot be found; their shares are consequently invested till they are traced. One (a married female) is now discovered to be dead—though alive at the time of distribution. Her husband had abandoned her some years previous to her death, and she died in a charity hospital. Is her husband entitled to this money? Or must it be distributed amongst her brothers and sisters living? All are decidedly against the husband, who, it is discovered, behaved very badly indeed.—X. Y. Z.

[52998.]—**Moon's Motion.**—I hope I shall not trouble you too much if I ask some further information about the moon's motion and her effect on the tides. I wish to know what effect would be produced by the moon's motion—which is very variable. If I take the N.A. for, say, 1855, the interval from new moon, Feb. 16th, to first quarter is 6 days 22h. 46m. 12s.; from first quarter to full moon, 8 days, 4h. 34m.; from full moon to last quarter, 7 days, 15h. 51m.; from last quarter to new moon again, 6 days, 14h. 45m. So it appears that the rate of the moon's motion is subject to considerable variation, for the first quarter is made in little more than 6 days, 22¾h. The second is only finished in 8 days, 4½h. In an old astronomy it is stated that the moon's absolute motion from her change to her first quarter is so much slower than the earth's that she falls about 240,000 miles behind her at her first quarter: that is, she falls back a space equal to her distance from the earth. From that time her motion is accelerated to her opposition when she is come up as far as the earth, having gained what she lost in her first quarter. From full to last quarter her motion continues accelerated, so as to be as far before the earth as she was behind it at her first quarter. The moon's motion is slower than the earth's from her third to her first quarter, and swifter than the earth's from her first to her third quarter. I scarcely understand what is meant by the expression that the moon's motion is "slower" and "swifter" than the earth's, as it is thus stated to be. However, this being the case, may I ask what would be the effect of the moon's variable motion on a body, such as the tides, as they follow the moon daily in her declination? It is also said the tides are sooner in the moon's first and third quarter, and keep back in the second and fourth. Why is this? Would a body on the earth following the moon's motion go to the east or come from the east? It seems at first sight that if the moon's motion is slower than the earth's, it should come from the east, and when swifter go to the east. The moon comes to the meridian so many minutes later every day. These minutes represent so many degrees, and I find that it is sometimes 10°, and sometimes 15°, or even more, in excess; but always later. Consequently, I fail to understand why it is said that the moon's motion is "slower" or "swifter" than the earth's.—George.

[52999.]—**Electro-Magnet.**—To Mr. J. Sprague.—In the issue of the "E. M." for Jan. 18, under the heading Electro-Magnets, paragraph 28, you describe an electro-magnet with only one helix. Would you kindly state whether the form will attract as powerfully as the ordinary horseshoe-shape with two helices? I have a number of small magnets to make, and if the one helix pattern is as powerful as the two helixes, it will save a lot of wire.—Amateur.

[53000.]—**Slide-Valve Motion.**—Will one of our kind readers please give me information as to how the valves of the L. & N.W. compound engines are worked? I am getting the patterns out for ½h.p. engine, and would like to apply it to the same. A slight sketch, if convenient, will greatly oblige.—A Mechanic.

[53001.]—**Cement Hearth.**—Can any of "ours" inform me of any method of whitening a cement hearth so that hot coals falling on it will not discolour it to any extent. Would like something that is not dusty. Is Asbestos paint any use?—Nemo.

[53002.]—**Strength of Beam.**—If a beam will support a load of four tons in the centre of a 6ft. span, what uniformly distributed load would it be safe to place on it over a 12ft. span? Does the safe weight decrease as the span increases, and in what proportion?—E. E. R.

[53003.]—**Soda and Alum.**—Will any chemical correspondent inform me what action takes place on mixing solutions of the above, and what is the deposit which is formed thereby?—J. H. S.

[53004.]—**Launch Engines.**—I shall be glad to know how to fix a pair of launch engines in a wooden boat, how to line out the position of the shafting. Also whether the process is the same for fixing engines in an iron boat? as, of course, it is easier to adjust the engines where fixed on wooden blocks.—F. Wallace.

[53005.]—**California.**—I shall be glad if any one can give me such information about California as is given in this week's Mechanic about Florida? My present intention is to go there to start fruit-growing; but I should like as much information as possible before fixing definitely.—J. M. M.

[53006.]—**Microscopical.**—Will Mr. Lewis Wright, "Monachus," or some other student of optics, explain what is "the usual system of converging lenses" used for showing the rings in crystals by polarised light, as referred to in the extract from *Jour.* R. Mic. Soc., given in "E.M.," p. 490? I have long wished to fit my microscope with an apparatus for this purpose, and shall be glad to be told how to do it. Further, how, or by what colour, are plates of selenite or mica (?)—giving, respectively, ¼ and $^{3}/_{4}$ wave retardation—to be identified? See "E. M.," p. 489.—Emeritus.

[53007.]—**Electric Gas Lighter.**—Can any of "ours" give instructions for recharging the battery used in above? Also particulars of construction.—Nemo.

[53008.]—**Legal.**—A deed of settlement is entered into on the marriage of A. and B. C., D., and E. are the trustees. It is desired by A. and B. to do away with the settlement, and discharge the trustees. The deed is in the hands of the solicitor who drew it—he being the adviser of D., one of the trustees—and he refuses to part with the deed, and evades even giving a copy of it to the solicitor of A. and B How can he be compelled to give up the deed, or a copy of it? What is the nature of the procedure required? C., the first trustee, is willing to assist. The solicitor of A. and B. does not like to take hostile steps against a townsman and fellow-practitioner.—U.

[53009.]—**Magneto-Electric Machine.**—I have one for medical purposes which has been put aside for some time, and now can get no shocks from it. The magnet is circular in form, and poles cut out in semicircular ends, between which an armature revolves, somewhat like Siemens'. On the axis of armature is the commutator. The reversion takes place when the two segments of iron portion of armature are opposite the poles of magnet. The connections are all clean and good. The large magnet is not very strong, and is 5½in. outside diam. The armature is wound longitudinally with very fine silk-covered wire, the ends being attached to the two semicircular portions of commutator. Will some one give me some assistance as to discovering cause?—W. H. H.

[53010.]—**Making Banjo.**—Can any reader kindly tell me of a method of making a drum for a banjo? I am pretty handy with my tools, and feel sure that I could make one, if some one would inform me of the best kind—American (with a back) or English (open)? The variety of wood used, how to bend it round, how to stretch the parchment?—P. A. I.

[53011.]—**Theiss Bridge.**—I should be pleased if any one would give me a section of the cylinders of the Theiss bridge at Szegedin, showing method of working, ingress and egress chambers, escapes and supply cocks, &c. Any information will oblige.—P. A. I.

[53012.]—**Escape of Steam.**—How many cubic feet of steam would escape into the open air from a 5-16in. circular pipe, the pressure-gauge on boiler being 35lb.? What is the formula?—Chas. Heard.

[53013.]—**Removing Colour from Fish Oil.**—Can any reader oblige me by giving a simple method of effecting this?—J. I. D.

[53014.]—**Cream in Condensed Milk.**—Some days ago I tried the First Swiss Brand condensed unsweetened milk, and found that after adding water the cream did not rise, and yet it is said no cream is abstracted from the milk previous to condensing. Will some one be kind enough to explain the mode of preparation, and say whether anything is added to the milk to prevent the cream rising?—Harrow.

[53015.] — **Expansion.** — Can anyone please answer me one or two questions on this point that I have asked before without getting any satisfactory reply? (1) If a gas is said to expand $\frac{1}{n}$ for each degree of heat, from 32° to 42° Fahr., does this mean that for each degree it expands $\frac{1}{n}$ of its bulk at 32°, or does it expand for every separate degree $\frac{1}{n}$ of its bulk at the temperature taken? Similarly, for expansion under barometrical pressure, is the increment equal in bulk at each 10th of an inch of mercury, say, from 26in. to 31in.? Or, is the increment for each 10th proportioned to its bulk at the point taken? (2) What is the law with liquids regarding this same question? (3) Can you give me the coefficient of expansion of sulphuric acid, glycerine, and petroleum respectively? Information on any of these points will much oblige.—Guido.

[53016.]—**Battery for Electric Light.**—I am about constructing a battery of 40 Bunsen cells for electric light, and should like to know what power light I ought to get from 40 cells? The size of carbons is 7 by 1½in. by 1in., zinc cylinders 6½ by 3in.; outer jars, 6 by 4in. inside measurement. The lamp I am going to use is the arc, with ½in. carbons; but please state what size you think best to obtain the best results from the number and size of cells given.—C. A. B.

[53017.]—**Electroplating.**—Would Mr. Lancaster kindly tell me the best method of connecting six quart bichromate cells (with Trouvé's solution) for electroplating? If joined up in multiple arc, would the E.M.F. of one cell be sufficient to deposit for three hours without giving the battery rest? Also tell me what current I might expect to get if joined up in this manner?—No Name.

[53018.]—**Convergent Lenses.**—Will some optical correspondent kindly give (in language that ordinary English mechanics can understand) a description of Nuremberg's polariscope and the convergent lenses referred to at p. 490? Perhaps Mr. Wenham will oblige, and give, at the same time, a diagram of a 1-12 dry micro.-objective, and one of a 1-12 water immersion, pointing out the difference in their construction, the position and foci of the flint and crown lenses of which they are built up.—D. T. K.

[53019.]—**Fixing Windows.**—Can any reader inform me of a good practical method of fitting the window sashes, especially those of the upper floors, in such a way that they can be readily taken out or reversed? My object in view is to enable windows to be easily cleaned without the cleaner having to get outside; also that sash-lines can be mended, or broken panes of glass repaired without necessitating the whole frame and beading having to be taken to pieces—to the great injury of the paint in a nicely-decorated room. An additional advantage would be gained if the plan adopted could, at same time, be utilised to tighten window-frames during bad weather in a house where the upper part is much exposed to sea air and south-westerly gales.—A. Lloyd.

[53020.]—**Who Discovered the Lunar Clefts?**—In Fontinelle's "Conversation on the Plurality of Worlds" the following passage occurs: "The illustrious M. Cassini, who has acquired a greater knowledge of the celestial bodies than any man in the world, discovered in the moon something which separates, then reunites, and afterwards loses itself in a cavity. We have reason to believe, from its appearance, that this is a river." I imagine that the Cassini referred to is John Dominic Cassini, the founder of the illustrious family of astronomers bearing this surname, who constructed a map of the moon in [illegible]. Can any of your readers inform me if they have seen in the works of J. D. Cassini, senr., a record of the observation to which Fontinelle refers. The passage can, it seems to me, be only understood to relate to something resembling a cleft or rill, though to Schroeter is always given the credit of discovering these remarkable objects. I am aware that Arago "Popular Astronomy," Vol. II. p. 257, Smyth and Grant's translation, refers to this passage in Fontinelle's "Conversations"; but he does not appear to have seen the original record on which it is founded.—Thos. Gwyn Elger.

[53021.]—**Confectionery.**—Will any of your readers inform me the description of apparatus used in confectionery for making sweets in the form of pills?—Wave.

[53022.]—**Black Colour for Cement.**—I am laying a cement floor at present, and want to colour it black. Could any reader inform me what the ingredients are to do so? I have tried lampblack; but it does not agree with the cement. Neither will engine ashes do alone.—A. W. [illegible]

[53023.] **Money Table.**—Could some reader of "ours" give me a table by which I could tell what I owe to a building society at any time I may wish to pay out—which is allowed by the society? I borrowed seven shares at £[illegible] each, at 5 per cent., on Feb. 13, 1873, and have paid from that date £[illegible] per month. How much should I have to pay in Feb., 1884, or at any other time to redeem my property?—[illegible]

[53024.]—**Wimshurst Influence Machine.**—I am constructing a Wimshurst solely on the instructions given in "ours." There are one or two little matters which I would like detailed—principally, the sectors and the method of cementing them to plates. I have made mine 2¼in. long, ¾in. at top, ½ at bottom, rounded at both ends. I intend cementing ¼in. from edge of plates. Will any one say if I am right? Also let me know what kind of cement I should use.—Very Much an Amateur.

[53025.]—**Varnish.**—Can any one suggest the best way to filter spirit varnish? Are there any filter presses in the market suitable for the purpose?—No. 3.

[53026.]—**Tempering Cooper's Tools.**—Will some reader inform me how electro-boracic steel is tempered in my trade (cooper)? Our principal cutting tools are made from it, and it is very rare now to get a tool tempered right (more frequently soft than hard).—Amateur.

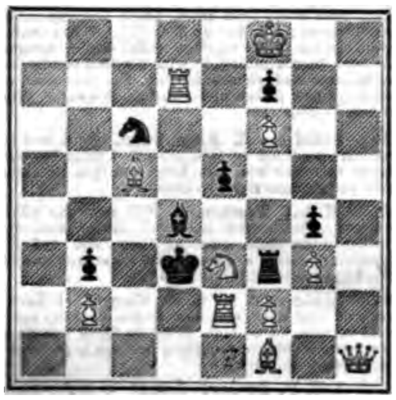
[53027.]—**Cistern.**—Will some reader give me an answer to the following in plain figures? A cistern lined out with 5lb. sheet lead to the square foot, 6ft. 8in. long, 4ft. 5in. broad, 2ft. 6in. high. What will be the weight of the sheet lead, and the quantity of water the cistern will hold?—Durham.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXXIV.—By J. Pierce.

Black.



White. [11+8

White to play and mate in two moves.

Solution to 872.

White.	*Black.*
1. Q B takes B	1. Kt takes B (a)
2. Q-K Kt 5 (ch)	2. B covers
3. B mates	
	(a) 1. Kt-Q 5 (b) or P moves
2. Q-K 4 (ch), &c.	
	(b) 1. B takes B (c)
2. Kt-Kt 6 (ch), &c.	
	(c) 1. Kt-K B 5
2. Q-B 6, &c.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 872 from W. J. Francis, J. G. E. (Sittingbourne), Rev. W. Anderson (Old Romney); to 871 from W. J. Francis.

R. A. Bennett.—You have overlooked in 872 that Black B can check at Q sq on first move.

Game received with thanks from J. Jowett.

Jequirity Poisoning of Fowls.—As a continuation of their work on jequirity MM. Cornil and Berlioz have recently read before the Académie de Médecine a further contribution on the effect of the bacilli of jequirity on fowls. A single injection of ten to twenty drops of the infusion into the subcutaneous connective tissue of the breast produces a rapid poisoning, terminating in death, the chief symptom being copious diarrhœa. The liquid stools contain numbers of the bacilli. The skin becomes infiltrated with a clear liquid, which abounds in bacilli; the great pectoral muscle becomes voluminous, as happens after an injection containing the microbe of the cholera of fowls. Microscopical examination of the muscle shows transverse ruptures and necrobiosis of the muscle fibres, with infiltration of the connective tissue by fibrin and lymphatic cells, just as in the cholera of fowls. With an injection of a small quantity the fowls remain alive, though a local œdema, with damage of the neighbouring muscle, is produced, but immunity is acquired. A fresh injection into the peritoneal cavity seems to be partly eliminated by the previously induced local mischief. The lesions set up by the microbes continue to evolve apparently after the complete elimination of the micro-organisms.—*Lancet.*

ANSWERS TO CORRESPONDENT

⁂ All communications should be addressed to the E of the English Mechanic, *31, Tavistock-street, Co Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put dr ings for illustrations on separate pieces of paper. 2. titles to queries, and when answering queries put numbers as well as the titles of the queries to whi replies refer. 3. No charge is made for inserting le queries, or replies. 4. Letters or queries asking for dresses of manufacturers or correspondents, or wh tools or other articles can be purchased, or replies gi such information, cannot be inserted except as adver ments. 5. No question asking for educational or sci information is answered through the post. 6. Letters to correspondents, under cover to the Editor, are not warded, and the names of correspondents are not gi to inquirers.

⁂ Attention is especially drawn to hint No. 4. pace devoted to letters, queries, and replies is mea the general good, and it is not fair to occupy it with tions such as are indicated above, which are only of vidual interest, and which, if not advertisements in the selves, lead to replies which are. The "Sixpenny S Column" offers a cheap means of obtaining such inform tion, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand to Wednesday evening, Feb. 13, and unacknowledg elsewhere:—

L. Balliolian.—John Wood.—A. Ireland.—W. D. T. Knowles.—W. T. N.—C. B. Allen.—An Old Su scriber.—Williams.—Vulcanite.—W. C. Hud R Morris.—L. T. B.—An Old Apprentice.—Upp Common Room.—J. Parker.—W. Bitch Spencer.—C. J. Woodward.—M. A.—Palmer.—L Sailor.—J. S. B.

Electric Light. (See the articles and recent replie is impossible to insert all the queries we receive dynamos of all sorts of patterns and sizes.)—J. K (Use japan. We do not know any method of it chemically. 2. You can coat brass with mercury rubbing over it a solution of the nitrate; but the is rendered rotten.)—Anxious. (You can obtain hydro gen by causing a current of electricity to deco pose water, or by putting zinc in a mixture sulphuric acid or in hydrochloric acid (making fluid by the latter process). Or you can obtain passing steam through a tube containing red-hot frag ments of iron. 2. We should like to know how separate oxygen from the atmosphere cheaply. We should patent the process at once. 3. Light car buretted hydrogen.)—C. L. Tweedale. (We cannot afford space for the elements of all the comets 1874. They have no doubt been given in our page and must be looked for therein, or in the Monthly *Notices* of the R.A.S.)—Electric Belt. (See the indices. You can make one of pieces of zinc copper separated by canvas wetted with salt and wat —R. C. (Quite possible, supposing the water power sufficient; but, under the circumstances, it would rather expensive.)—T. Wilson. (Use as much sug as the water will dissolve, and add more as the proce goes on. Merely keep it in a moderately warm tem perature. The time depends on the size of the "plant.")—Potato. (By maceration and washing. For making dextrine and a variety of purposes in which starch is used.)—Enquirer of Rosin Stick. (We can offer no opinion without more information.)— Rosin Stick. (How can anyone say, when it depend entirely on individual capacity? As a rule, it is to late to begin.)—A Young Engineer. (See back num bers. You do not say what point it is you require formation on, but you will find it by referring to th indices.)—Sonnerie. (The connection to the gas ma is decidedly objectionable; but the bend is not. Anderson's book on "Lightning Conductors" (Spo or the report of the Lightning-rod Conference, publishers. See also the indices of back volumes.)— Amateur Musicians. (What do you mean—a pian forte, a dulcimer, or what? You will find directi for making most instruments of "wire and wo" the back volumes.)—Aquarius. (You will find it bine the best arrangement for dimensions so —Birmingham. (No; not into a gas-engine: but might perhaps be converted into a water motor— doubtful success, though. See No. 837, and the in of back volumes.)—W. Routledge. (That is wh meant by the term "suction.")—H. H. H. (You find tests in back numbers, and the price of a new in makers' lists.)—Iota. (No newspaper, if that what you mean; but several serials (mostly monthl though they are not of a popular character.)— Whiting. (We do not know of such a book. The a good deal on the subject in back volumes.)—Pe (1. You can soak your pots in melted paraffin; or them with pitch varnish, or a dozen other things. varnish, apply the coating inside. 2. Simply a brass lever pivoted at one end which slides from button to another. 3. For the furnace, see pp. 12 Vol. XXXIV., and the indices generally.)—J (See p. 559, last volume. The surface is brought with pumice powder, and the polish with putty po and water.)—Aberdeenshire. (They are the comm cial names. Why not have written to the patent Their address was given.)—N. (When they use pl at all, they use the best, and dry their moulds on in an oven.)—Studious. (The method of making solution has been repeatedly given in recent numbers Debeno. (Have you tried to take them in the u way?)—Dew Drop. (See p. 73, No. 913. The query is an advertisement.)—Dewsbury. (Impos to say without seeing; they are usually held by bi screws, or by being pinched into brass channels Bean. (The usual recipe is—Work for an hour in a b with 2oz. chrome and 4oz. alum; lift out and expo the air until cold, then work for an hour in a bath 3lb. fustic and 1½lb. logwood; wash out and dry. You can purchase much cheaper than you can m See the indices.)—M. Trechelett. (They are co pounded from hops, buchu, mandrake, and dandeli but the proportions have not been published.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 22, 1884.

AN AMERICAN TRIAL OF AN OTTO GAS-ENGINE.

AN elaborate series of experiments made at the Stevens Institute of Technology to determine not only the actual efficiency and economy of an Otto gas-engine, but also the extent and proportions of the losses met with in its ordinary operation, has been carried out by Messrs. M. Brooks and J. E. Steward. The capability of these gentlemen is vouched for by Prof. R. H. Thurston, who writes an introduction to their exhaustive paper, which appears in the current number of *Van Nostrand's Magazine*. Some earlier investigations, carried out by Prof. Thurston and his assistant, Mr. Cartwright, had given a fairly good idea of the causes of waste in the gas-engine; but the former thought the collection of further data desirable: hence the elaborate report made by Messrs. Brooks and Steward of no fewer than 20 trials of a 10 h.p. (indicated) Otto gas-engine. In Prof. Thurston's experiments, he found the consumption of water-gas to vary from 21·2 cubic feet per hour per horse power in engines of 6 to 7 i.h.p., to 24·5 cubic feet in engines of 2 h.p. or less. The friction of the engine varied from 40 per cent. of the power in the smaller to 20 per cent. in the larger engines, while the waste at the exhaust ranged from 12 per cent. of the total heat of combustion in the small engines to 24 per cent. in the large. The water jacket carried off from 45 to 55 per cent. of all the heat supplied by the combustion of the gas. Except that corrections will have to be made for the price of gas, the report of Messrs. Brooks and Steward will be found of considerable value in this country, for their twenty trials were made, so far as concerns one moiety, with varying powers, while the other half were made at full power, but with slight differences in the number of revolutions per minute. From the figures supplied by these trials, it appears that the total heat accounted for thermodynamically is 34 per cent. of the total quantity supplied by the combustion of the gas, consisting of the heat actually transformed into work and that expelled with the exhaust; the water-jacket, radiation, &c., account for the other 66 per cent. It follows, then, that if this loss can be materially reduced the gas-engine would at once take a far more prominent position than it has already done; for its convenience, safety, and economy all combine even now to render it *the* motor for small power-users, especially in cases where the power is required intermittently. The engine tested at the Stevens Institute has a stroke of 14in., and the diameter of the piston is 8½in. It has two flywheels, weighing together 1,650lb., and a pulley 30in. in diameter was used in connection with a Prony brake. Both gas and air were taken from rubber bags after passing through meters, and even the quantity of water was measured (as well as its temperature before entering and after leaving the jacket), though that is not material to the experiment, as the same water is used over and over again. A pyrometer in the exhaust gave the temperature of the discharged gases; a Tabor indicator was mounted directly on the cover of the exhaust passage, and a speed counter was attached to the link moving the slide-valve. We mention these details to show that the trial was carried out thoroughly; but our space will not enable us to reproduce the elaborate table in which the results of the tests are set out. It must suffice to notice the chief points. The gas used in the experiments was that obtained from the street mains of Hoboken, New Jersey, which, besides costing 10s. per 1,000 cubic feet, is, it seems, of rather poor quality, so much so that the reporters make a special note in which they show that 21 cubic feet of average good quality illuminating gas is sufficient to develop one horse-power per hour in the Otto engine. The gas consumption with varying power was found to be nearly constant per i.h.p., but of necessity varied with the effective horse-power, because the friction increases in proportion to the useful work. The figures given under these heads show the value of the governor, which cuts off gas whenever there is an excess of speed, and thus insures economy in consumption when the engine is not required to exert its full power. The experiments to determine the ratio of air to gas gave about seven of air to one of gas, and, making allowance for the poor quality of Hoboken gas, that indicates that the ratio of 10 to 1 usually assigned must be slightly in error, due no doubt to the method adopted in ascertaining the ratio —viz., by taking the volume of the piston displacement less the measured amount of gas. The ratio obtained at the Stevens Institute is that of actual measurement, and some tests were made to show the effect of increasing the proportion of air, the result being that it is found to be false economy to throttle the gas supply, as the consumption increases per effective horse-power, though little difference is noted per i.h.p. From the figures given in the table it appears that the amount of heat carried off by the water is about half the total heat given by the combustion of the gas; but when the cylinder is kept cool by a plentiful supply the quantity of heat carried away appears to be greater than when less water is used and the cylinder is allowed to become warmer. When a comparison is made with the indicated or the actual work it is found that no advantage is to be obtained by using the minimum quantity of water, and the authors suggest, as a probable explanation, that much more heat is lost by direct radiation when the cylinder is warm than when it is cool. Messrs. Brooks and Steward have rendered their report complete by entering into an explanation of the theory, taking the thermal constants of the gas, the air necessary for complete combustion, specific heats, and a number of indicator diagrams into consideration. As the latter fail to account for 40 per cent. of the total heat, and as it is certain that the heat carried away by the water-jacket comes from the gas, it becomes of some importance to learn exactly what occurs. According to Messrs. Brooks and Steward, it is a well-established fact that heat decomposes chemical compounds. Carbonic acid, for instance, is separated into carbonic oxide and oxygen at a comparatively low temperature. At the temperature reached in a gas-engine after an explosion it is almost certain that this action of dissociation occurs, and prevents the complete combustion of the gas taking place instantly. As the temperature decreases from expansion further burning ensues; and thus they say it is quite possible that the gas is not fully burned until after the opening of the exhaust valve. This view is certainly worthy of attention, as it serves to point out the direction in which further improvement should take place. From these trials it may be stated that the efficiency of a gas-engine of the Otto pattern is 18 per cent. indicated of the total heat of combustion, and 14½ per cent. actual useful work. The best steam-engines utilise only 10 per cent. of the heat-units of the coal, and small engines rarely exceed 5 per cent.; so that it seems clear that the gas-engine is by far the more perfect heat-engine. An estimate of the running cost and interest on capital of a gas, steam, and hot-air engine in America gives the relative positions as steam, hot-air, gas; but the position of the latter is due entirely to the high cost of coal-gas in that country (10s. per 1,000 cubic feet), and, as Prof. Thurston says, "even now the gas-engine has found innumerable applications." As its running cost is reduced by the use of special gases, and its economy is increased by improvements in design and construction, the field of its usefulness will, he thinks, indefinitely widen. In this connection it may be mentioned that the Dowson water-gas, as used at Messrs. Crossley's works, gives one i.h.p. an hour on a consumption of 1·4lb. of anthracite—one attendant being sufficient to look after Dowson gas apparatus capable of supplying 300 i.h.p. The only steam in their large works is that found absolutely necessary in working steam-hammers.

REVIEWS.

The Art of Soap-making. By ALEXANDER WATT. London: Crosby Lockwood and Co.

IN his preface, Mr. Watt says he has, in compiling this book, endeavoured to fill a void in English technical literature, for, so far as he is aware, the art of soap-making has been left without a textbook adapted to the wants of the many. We believe that is to a certain extent true, although there are many cyclopædias, &c., which contain the elements of the art, and several translations of works by foreign authors, from which latter Mr. Watt has drawn much of his information. The art of soap-making is to be found in those special blue-books issued by the Patent Office; but to understand many of them one must be already an expert, whereas it is some handbook that would give the practical details of routine, manufacture, and recipes of known value that has been wanted. We think we may say that Mr. Watt has supplied the want, although it must not be forgotten that soap-making, to be commercially successful, requires the services of a competent chemist who is also familiar with the details of the factory. Chevreul, the distinguished and venerable French chemist, was one of the first to clearly explain the nature of the reactions when fatty substances are treated with boiling solutions of caustic alkali; but it was not until keen competition made itself felt that soap-making was elevated into an art. In his first chapter Mr. Watt explains saponification, giving Chevreul's theory, and an epitome of Liebig's researches, with some remarks on the great importance to the soap-maker of a knowledge of alkalimetry. The succeeding chapters take us at once to a brief description of the works, and the materials employed therein, and Chapter V. treats on the manufacture of hard soaps, that is those made by a combination of soda and water with fatty matters; soft soaps being combinations of potash with certain kinds of oil, mostly those of inferior quality, as horse-oil, fish-oil, &c. Castile soap is properly made from a pure olive oil of the third quality—that is, the oil obtained by boiling the residuum of the presses in water; while London mottled is a combination of kitchen stuff or any cheap fat with the crude soda known as black ash, the impurities in which impart the mottled or marbled strike. The abolition of the Excise duty on soap gave an impetus to invention, and accordingly we find in this book a chapter on cheapened soaps, in which Dr. Normandy's process is described, and those processes which utilise the silicates of soda and potash. These silicates and fuller's earth can scarcely be considered adulterants, as they possess detergent properties themselves; but the silicate soaps are at any rate not suited for toilet purposes—though [illegible]

[illegible]

[illegible] is a practical [illegible] as a useful [illegible] and a valuable [illegible] landlords. It [illegible] various kinds of [illegible] apparently in- [illegible] necessary, from [illegible] boxes.—*T*[illegible]

[illegible] *Masonry*, by [illegible] Baillière, Tindall [illegible] of what is known [illegible] *drawing*. It is [illegible] and Sons, are fairly [illegible] designs, which [illegible] amateur carvers, and [illegible]

THE DIALYTE TELES

By W. Bre

MY attention having been [illegible] articles on the telescope [illegible] years ago in *Design and Work* [illegible] that some very good [illegible] given. The writer recommends [illegible] thickness 21 or 22 Birmingh [illegible] inside diameter, and [illegible] lens is a 5in., giving 4 [illegible] "ultimate" focus [illegible] are as follows:

[illegible] crown object [illegible] apertur

[illegible] convex crown, radius...
[illegible] concave (Chance's heavy flint [illegible]
[illegible] sides towards each other [illegible]
Distance of correctors from o.g., about [illegible]

I cannot understand how a 20in. plan [illegible] be used for this combination [illegible] focus would be something und [illegible] length. Perhaps it is a misprint [illegible] which seems much nearer the focus gi [illegible] would give a length of nearly 5ft., which [illegible] certainly be lengthened to 6ft. by the [illegible] the correctors.

Inside the large tube is a short [illegible] 12in. long, fitting very closely; this is fla [illegible] the interior side at one end, and thro [illegible] circular aperture thus formed a short br [illegible] having an outside flange, is passed. Fo [illegible] unite the adjacent flanges, thus servi [illegible] means of regulating the axial adjustme [illegible] corrector tube is double, consisting of [illegible] tube containing the flint lens, sliding [illegible] within an outer one containing the cr [illegible] This outer tube slides accurately thr [illegible] short brass tube just mentioned: therefore [illegible] the correctors may approach to or rec [illegible] the object lens by moving the double tu [illegible] short one; or, secondly, the correctors [illegible] separated from each other by withdra [illegible] inner part of the double tube. The first [illegible] serves to correct the chromatic error; the [illegible] to correct the spheric aberration. [illegible] some means must be provided to preve [illegible] adjustments being upset by any move [illegible] telescope. I do not see this point notic [illegible] writer of the articles.

After the places of the lenses have been [illegible] determined, the mounting must be put [illegible] for fine adjustment; but, before this can [illegible] the centres of the parts must be [illegible] aligned. To do this, the writer recomme [illegible] the lenses to be removed, and three [illegible] right-angled cross wires to be prepared [illegible] first pair to be placed across the object e [illegible] the second and third pairs at each end tubes carrying the crown and flint hen by placing the eye at the hole in ce, the corrector tube must be shifted the intersections are brought in a line. made in the large tube to allow access rector fittings.

tly two movements must be provided e attachment of the corrector mount to ar. For, first, the centre of the corrector y be eccentric to that of the large tube; ondly, the centre lines of the two tubes athwart each other. The second error remedied by tilting the flange of the rass tube, that is by inserting packing n it and its neighbour, in the proper place g the axes to parallelism. If the centres n eccentric, the brass tube must be moved ly until the error is removed. This itates the screw-holes in the flange being nough to allow some displacement.

n afraid this centring process will be found ost tedious and irksome job connected with alyte. It will certainly be no easy matter at a delicate adjustment by shifting the s in the narrow confined space between the ubes, as they are anything but get-at-able at position. I am of opinion the following is more practicable. If the large tube is ght and parallel it is certainly better. ure a brass tube which will carry the double of the correctors. At each end of this fix wo circular discs or flanges; mount the tube true mandrel and turn up each end exactly e to fit into the large tube. But, if the trues of the large tube cannot be depended on, I do see a simpler or easier plan than the following. rn the discs less in diameter than the inside the tube. Next, having roughly determined place of the correctors, fix two stout brass ngs on the outside of the large tube, so that ch shall be exactly over the flanges inside. ut four screws equally apart through each ring. et these screws be fairly thick, with coned oints; they are best of steel, without heads, with saw-cut for the screwdriver through their ubstance; they will then be less likely to catch r get disarranged. Screw down lightly at first, o as just to dint the flanges; take out the mount, nd deepen these marks with a centre punch. Then, by means of these screws, the correctors may be adjusted to any degree of nicety, and they serve also to keep the mount in position.

With regard to the process of correction, the writer observes: — "The eyepiece must be inserted in its place, and the test object kept in the *centre of field* of view. For the chromatic correction, cleanly cut red and blue or violet letters, placed in a bright light on a white ground, about 50 or 60 yards distance, make an excellent guide.

"For the spherical aberration, a finely-lined watch dial, placed in a strong light at about the same distance, and viewed alternately by the centre and edge of the o.g.,' forms a good test. A slight over-correction in each case will afford finer definition with these instruments than the opposite error. The equal appearance of the enlarged star disc, when the eyepiece is moved to equal distances within and without the focus is not to be relied upon as a test for a dialyte telescope."

The correction of the oblique chromatism "may be brought about by drawing out the tube containing the field lens of the eyepiece, until an object is found to cross the field of view without any disagreeable display of colour.

"The eyepiece used should be of the Huyghenian type, but the lenses should have their respective foci in the proportion of 3½ or 4 to 1.

"Errors of centring will show themselves in an unequally coloured field, and, if the objective is not square to the axis, the diffraction rings will be thrown eccentric with the image."

The writer assigns the following reasons why it is preferable to use a plano-convex object lens:—"For the perfect correction of the *spherical aberration*, the compound lens must be so calculated that it shall, when in contact, somewhat *over-correct* the aberration of the object lens. A perfect balance may then readily be brought about by slightly separating the lenses." Hence he advocates the use of a plano-convex, because its error is greater than that of a double convex, and it may also be increased by reversing the lens.

To find the foci of the correctors, the same rule is used as I have already explained. But, it may be remarked that this rule is not exactly correct unless each corrector has the same focus. This cannot be so when the same curves are used for each lens. It is the ordinary plan to make them alike; hence, we can be certain that the negative error is in excess — chromatically, *always* — spherically, *sometimes* — depending on how the curves are arranged. The heavier the flint, the more will its refraction and dispersion preponderate.

To find the diameter of the correctors the following rule is given.

$$x = \frac{d\,(A-a)}{F} + a$$

"Where x represents the diameter (that is, the clear effective aperture) of the correcting lenses; d the distance of their centres from the focus of the object lens; A, the effective aperture of the object lens; F, its principal focus; and a, the diameter of the field lens of the lowest power eyepiece it is proposed to use."

If d is half the focal distance F, then $x = \frac{1}{2}(A + a)$; or if one-third, $x = \frac{1}{3}(A + 2a)$. Those who contemplate making a dialyte, would do well to read the articles in the journal I have named.* They are excellent in many respects, though I think the writer's plan of a corrector mount may be much improved. Also it is probable that a series of circular cards, perforated with a small hole at the centre might be more readily applied in the alignment of centres than three systems of cross wires. A bright light might be placed so as to be visible at the eye-cap through the hole at the centre of the object end; then the corrector tube would have to be so placed as not to interrupt the line of vision.

The writer mentions a dialyte made by Professor Wilson, of Glasgow, in 1828, which had the following dimensions:—

Crown glass index, 1·53; dispersive power, ·032.

Flint glass index, 1·58; dispersive power, ·052.

Plano-convex object lens, 4in. aperture, 48in. focus, mounted in a tube 6ft. long, with plane side outwards.

Correctors, plano-convex and plano-concave, 2in. aperture, and each curved to a radius of 3·71, and placed 26in. from the object lens.

I have been favoured with an account of a dialyte made by a gentleman, who, I presume, has, to a certain extent followed the directions given in the papers just quoted. It appears to be of the same dimensions, and of glass of a similar quality. The account is as follows:—

"The o.g. (5in. aperture) was made out of a piece of carefully selected plate-glass, plano-convex, radius 30in., focus 60in. The correctors, 2½in. diameter, were made from a pair of Swiss discs; the density of the flint being 3·67, almost the same as Chance's 'dense flint,' and the density of the crown about the same as Chance's, i.e., 2·55. The crown lens was plano-convex, 5in. radius; the flint, plano-concave, also 5in. radius. The o.g. was mounted in brass cell, end and cap. The correctors in two tubes, one sliding within the other, and these tubes together sliding in a short tube with two brass rings, one at each end, just fitting tightly in the main tube of the telescope. This main tube was of zinc covered with American cloth; the polished brass ends gave it a satisfactory appearance. It had a door in the proper place for introducing the hand to adjust the correctors. The eyepiece was made so that the field lens could be separated considerably from the eye lens, and rack motion to focus was provided.

"The correctors and eyepiece were adjusted together in the tube for colour and spherical aberration on a watch dial at about 100 yards distance, and carefully centred. All the adjustments being correct, it was found that the colour was well corrected; and, to correct the spherical aberration, the lenses of the correctors had to be very slightly separated. The definition on the moon, planets, and stars was very fair indeed when the object was kept in the centre of the field."

In concluding my notice of the dialyte, I think it will be admitted that it is not advisable to resort to this form for apertures less than 4½in. or 5in.; and, even in this case, if the amateur has to get nearly all his work done for him to order, it would probably be more satisfactory to buy a less instument on the ordinary construction. If he can grind his own lenses, or more especially if he can do his own fitting and mounting, then the cost of the instrument should not run into a large sum. It is rather remarkable that no practical optician advertises dialyte lenses for sale. A 5in. plate, plano-convex, 30in. radius, and two 2½in. convex and concave planos, 5in. radius, are very simple forms; and, if one may judge from the prices of other similar lenses, the lot ought to be obtainable for under 30s. Looking over some back volumes of this journal, I find 5in. single object lens and eyepiece advertised at 10s. 6d., and most certainly the pair of correctors ought to be had for 12s. or 15s., for glass of ordinary quality. Probably the focal length of such single-object lenses as I have alluded to would be too great to turn into a convenient dialyte, but a shorter focus should not cause extra expense.

PRACTICAL NOTES ON PLUMBING.—XCIV.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 508.)

The Theory of the Circulation of Hot Water through Pipes, &c.

IT would appear (from the preceding facts) plain that the colder the water the heavier it will be, while the lighter and warmer the particles will rise to the surface; but even in this there is a limit, which can only go down to 40° F., and from this point down to 32° F., when the molecules of water undergo a very remarkable change. Between the above degrees there is no contraction nor expansion, therefore it, bulk for bulk, does not become heavier nor lighter; but we are surprised to find its bulk increase when the degree of heat is below 32° F., when it crystallises into ice, and this expansion goes on in strict accordance to each degree of cold below the 32°, hence the reason why leaden and other pipes burst in times of frost. Of course my readers have seen ice floating on the surface of water, which will prove the above assertions in the most conclusive manner.

From the above it is plain that the circulation of hot water is brought about owing to the difference in the weight of the water at different points, caused simply by the expansion and contraction of the water itself; therefore, if the source of heat be permanent, the particles are rapidly brought into action, and the particles in a vertical tube soon become heated, and by their expansion must exert a pressure on all parts of the pipes, branches included. Now this, together with the levity of the water in the boiler, establishes a current, when the cold water from the coils, branches, &c., commences to flow in the direction of the boiler, and thus supplying the heavy or colder water continually, which, of course, takes the place of the lighter particles, known as hot water. To find the force with which the colder water runs towards the boiler, you must know the specific gravities of the water in the flow and return pipes, the flow being the ascending, and the return the descending; the difference between them will be the motive power, or the effective pressure. You can arrive at this point by ascertaining the temperature of the water in the return pipe and boiler, or flow pipe. If the difference in heat is only a few degrees, of course the difference in the speed of circulation of the water will be accordingly; say it is only four or five degrees, which is very small, but quite sufficient in a well-arranged system to maintain constant circulation. Let us assume that we have 8° of heat in our boiler B (see Fig. 438, A), the return pipe is standing at 180° and the flow to be 188°. Let the top of the flow pipe at F be, say, 18° above the top of the return R; the difference in weight will be about one-third of an ounce on the square inch, and this will be the amount of motive power obtained for the circulation, no matter what may be the length of pipes attached to the apparatus; and should there be, say, 50 yards of 4in. pipe, which will contain 80 gallons of water, with a 15-gallon boiler, you will then have 95 gallons, or 950lb. weight, kept in continual motion by the 8° of heat, or one-third of an ounce pressure.

Of course, the size of pipes will make a wide difference in the motive power, which increases with the size of the pipes; thus, in a 4in. pipe you will get four times as much as in a 2in., and so on, but, as the resistance increases equally with the power, the actual working effect is precisely the same in all sized pipes.

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* They appear at pages 292, 369, and 450, Vol. V., 1878.

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Again, the motive power can be increased by allowing the water to cool down before it gets back to the boiler, either by increasing the height of the flow and return pipes, or by doubling the difference of the temperature between flow and return, or, of course, an extra power can be obtained by doubling the difference of the temperature between the return and flow pipes, when the same increase of power is obtained as by the doubling of the vertical heights; or by trebling the vertical height of the flow and return pipes the same effect is produced as by trebling the difference in the temperature of the water.

A difference in the motive power is also made by diminishing the diameter of the pipe in such a manner that a longer amount of surface will be exposed, and in proportion to the amount of water within this, of course, allows more cooling surface, and consequently the return pipes can give off more heat in a given time, thus making the return water denser, and consequently quicker in action. Of course, when you do this you have more friction, which will be readily understood from the following:

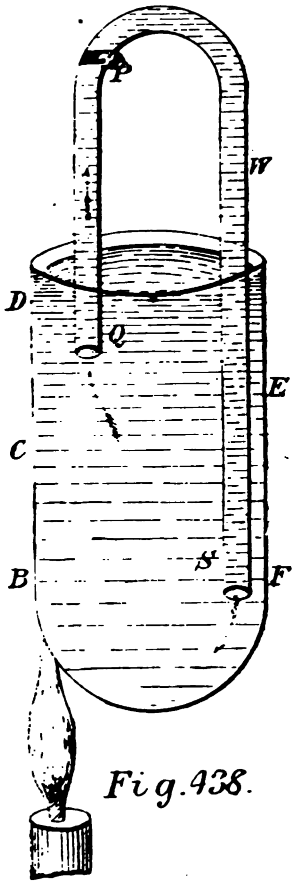


Fig. 438.

It is certain that the sides of the pipes greatly retard the flow of water, therefore a considerable deduction must be made, in some cases to the enormous extent of 80 per cent. In small pipes there is a greater amount of friction than in larger ones, owing to the relative amount of surfaces; besides, this small pipes cool quicker than larger ones, and thus the velocity is increased, as also is the friction, so that supposing we have a 4in. pipe, the amount of friction is, say, 1, in a 2in. there is twice as much, and in a 1in. four times as much as in a 4in., and you should also know that by increasing the velocity, so in proportion will be the friction nearly as the square of the velocity. It should also be known that in all hot-water apparatus the speed of circulation varies according to circumstances, therefore it is difficult to calculate; one thing is certain, that the velocity in all hot-water pipes is quickest in their centres.

The following is an easy method for estimating the velocity of hot water through pipes. Take an inverted siphon, Fig. 438, B, and place one inch of mercury in one leg, as at B G, and water in the other, as at A B; it will be found that the inch of mercury, B G, will balance 13½in. of water at A B, thus proving that the difference of the specific gravity is 13½ to 1. But suppose you use oil instead of mercury, then the water, bulk for bulk, will be the heaviest, and a column of 18in. of water will balance 2 columns of 20in. of oil; now suppose we have a turned off stopcock at X, and then put oil in one side of the siphon and water in the other, so that each fluid will stand at one level. Now suddenly open the stopcock, and you will find the oil to be forced upwards with equal velocity to that of a solid body falling by gravity through a space equal to the additional height which the lighter body would occupy in the siphon. Seeing that the relative weights of oil and water are as 9 is to 10, the oil must by the water be forced upwards with a velocity equal to that which a falling body would acquire in falling through one inch of space, which is equal to a velocity of 138ft. per minute, therefore you must estimate the speed of water in a hot-water pipe by the above rule.

Now, suppose your flow and return pipe columns to be 10ft. high, and your flow pipe to be 8 degrees hotter than the return, the hottest column of water will stand at ·331 of an inch higher than the colder, or there will be rather more than $\frac{3}{10}$th of an inch the difference in the height of the two standing columns, which will give a velocity of 79·2ft. per minute; or if the height be only 5ft. and the temperature as above, then the velocity will be 55·2ft. per minute, showing that the height of the two water columns, viz. 5ft. and 10ft., make a wide difference in the velocity of the flowing water. We will suppose the above temperature to be now doubled, viz 16°, and the height of flow and return to be 5ft. Now, that being so, the velocity will be 79·2ft. per minute, and so on proportionately.

Now that you thoroughly understand the principle of the circulation of the particles of water through pipes, &c., all the other work will be simple. You will find that the fittings described and illustrated will, after what I shall write, be A B C to you, more especially as I intend to explain them in the simplest manner possible.

(*To be continued.*)

COMMON LATHE TOOLS.—I.

BY the kind permission of the Editor, I am enabled to expand the articles on "Tools for a Cheap Lathe," as suggested by "West Bromwich" (letter 22274), into a more pretentious, and, as I think, more widely useful series on wood-working tools in general. This subject—interesting to all who, without having had a mechanical training, occupy some of their leisure hours with mechanical pursuits—I propose to divide into the two heads of—

I. Common lathe tools.
II. Common wood-working tools.

The workman gains his knowledge of tools by experience; the apprentice can always get his foreman or a fellow-workman to purchase his first set; but the amateur is entirely at the mercy of the shopkeeper, who often knows as little of the matter as his customer, and, even if he gets a good article, the chances are that he renders it unfit for use within a week through bad grinding or sharpening. I think, therefore, I shall not be disappointed if I assume that a few practical hints on the above-named subjects, embodying the experience of some 20 years in the workshop will prove interesting to a large section of our readers.

Common lathe tools may be few or many, according to the requirements of their owner, and tools for wood working or for metal working may predominate, according to taste. A workman is always adding to his stock of tools, until by-and-by he almost insensibly finds himself in possession of a very varied assortment, each member of which has a special use and a special history. From among my own lathe tools I will select and describe those which I consider either absolutely essential or of very general adaptability, and all the rest beside are merely modifications of these few and simple types.

Once for all, let me say that excellence in the production of plain turned work, whether of wood or metal, does not necessarily follow from the possession of a large quantity of tools, but depends entirely upon skill in their manipulation. In the hands of a professional woodturner a simple gouge is a marvellous tool, producing hollows, ogee's, and mouldings of various shapes with swift dexterity, aided only by the chisel where sharp corners are concerned. Those who handle the gouge with confidence and skill can turn out their work quicker, cleaner, and better than those who, dreading a disastrous "kick" or "catch," scrape away cautiously with round nose and chisel and diamond point. Therefore plenty of practice with the gouge is essential to the acquirement of a perfect command of the tool, and he who has acquired this mastery is, to a very great extent, independent of the rest.

The chief tools therefore required for wood turnery are plain gouges and chisels. An inch gouge, that is one an inch wide, is the largest that can well be used with a light treadle lathe, and to use that effectively means hard leg work. A ½in., ⅜in., or ¼in. will be more generally useful by far. The gouges should be well rounded in grinding Fig. 1, so that the point, and not the corners, shall be used for cutting, and they, in common with most of the other tools should be furnished with long handles—of which more presently.

In turning straight stuff, either between centres or on the face plate, the gouge may be held flat on its back without any danger of its catching in the wood; but, in turning mouldings and in boring holes with the cup chuck, the tool must be held *sideways*, and the corner of the gouge which is lowest, or, rather, speaking more correctly, some portion of that half of the gouge which is lowest, is the one that will be used for cutting, the higher corner being carefully kept away from the revolving wood to prevent a catch. Even, however, in rapidly roughing down plain wood surfaces, it is advantageous to handle the gouge in this fashion, using both sides alternately, since it cuts the wood quicker, cleaner, and with less friction than when used on the flat. Many amateurs become disheartened in their first attempts at turning, because of the difficulty of guiding and controlling the gouge. This is a lesson only to be learned by practice. The great thing is to *feel* the work. Thus, if turning down a moulding or, say, the ball on the end of a curtain pole, from circumference towards centre, there is the centrifugal force very sensibly tending to throw the gouge outwards, and this, of course, is the force which must be resisted. The point of the gouge, or a portion just below the point, will be used, as offering least friction, *and it* must be grasped *very firmly*. In turning a flat surface, no such force exists, and the gouge may *be held* indifferently in any position and comparatively slack. Always the end of the gouge handle is held in the right hand, while the three last fingers of the left grasp the lower portion of the gouge itself. The requisite guidance is imparted to the tool by the thumb of the left hand, while the opposite forefinger passes underneath the rest, in oppostion to the thumb, thus gripping the tool as in a vice (Fig 19). Lastly keep the rest close to the work. If you have a wide space, you get too much leverage on the overhanging portion of the tool, and may catch and break your tool. The big gouges are stout enough to stand rough work safely; but the ¼in. gouge is a more delicate tool, and should not be used at all for roughing down stuff in the lathe, except it be of small diameter. These remarks may appear slight, but they really embody about all that can be said on the subject. Let the young aspirant bear in mind each direction, down to the very minutest, and he will find, when by much practice he has gained expertness in the use of the gouge, that all essential hints have been comprised in these few words.

Shopkeepers are always ready to "warrant" the tools of a respectable manufacturer—that is, if found useless on trial, they engage to exchange them, sending the bad articles back to the manufacturer. But sometimes, in the case of broken tools, they will dispute the justice of the claim made by the purchaser. The tool may have been broken by the purchaser's carelessness, and the only way in which the latter can prove his claim to have the article exchanged is by showing the presence of a flaw in the broken part. If, when the tool breaks, a dark spot (Fig. 2) is seen to occupy a portion of the line of fracture, that is a "flaw," or crack, and is quite sufficient to account for the breakage, and to condemn the tool. The dark spot is simply the film of rust which has formed over the old line of fracture. It should be taken back while the new fracture is fresh and clean, and easily distinguishable from the old.

A gouge for soft wood is generally ground at a long angle, similar to that shown in Fig. 3;

Fig. 1.

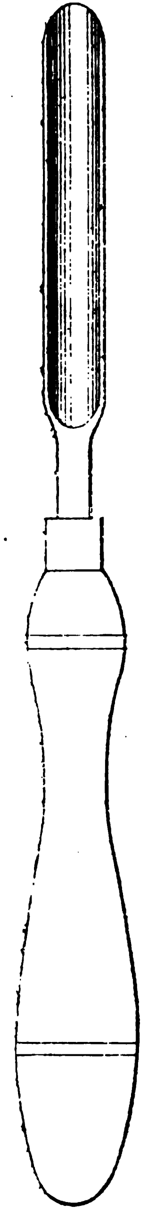


Fig. 4.

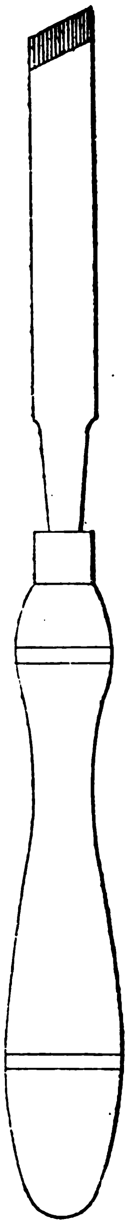


Fig. 10.

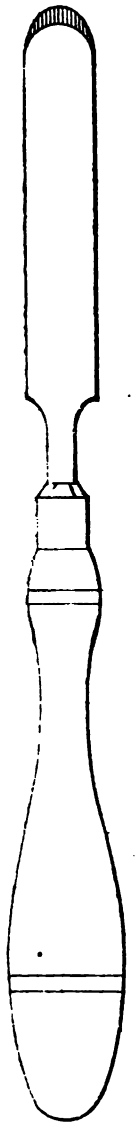


Fig. 13.

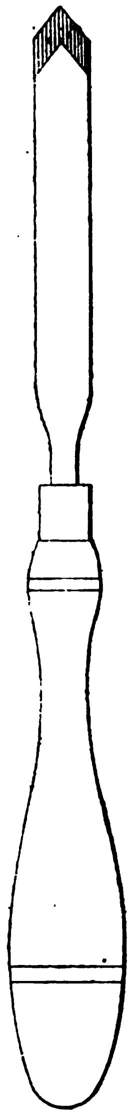


Fig. 11

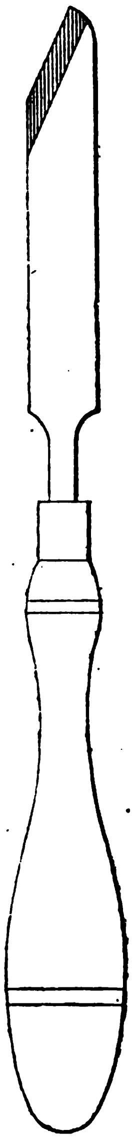


Fig. 12.

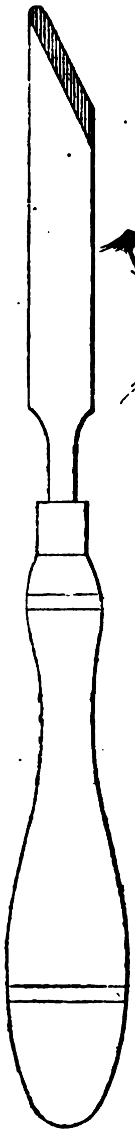


Fig. 19.

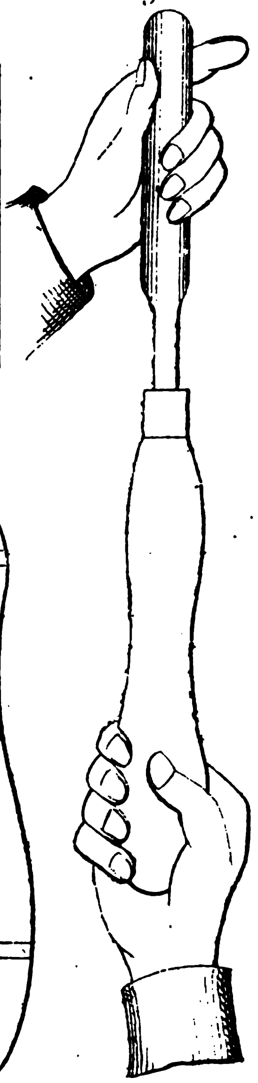


Fig. 2.

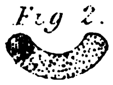


Fig. 6.

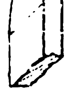


Fig. 5.

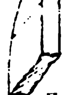


Fig. 16.

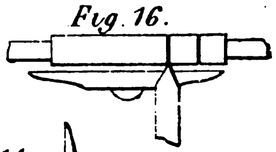


Fig. 15.

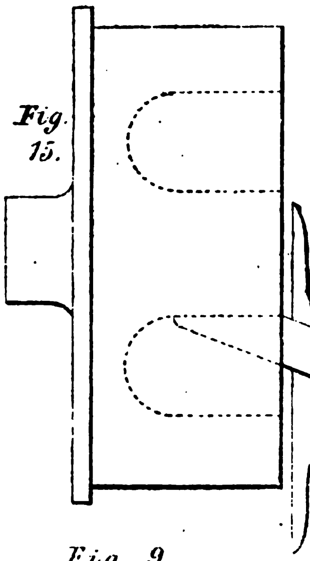


Fig. 8.

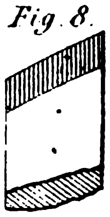


Fig. 3.

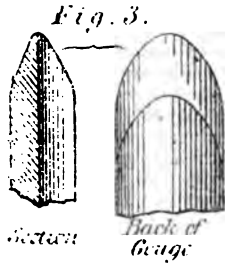


Fig. 14.

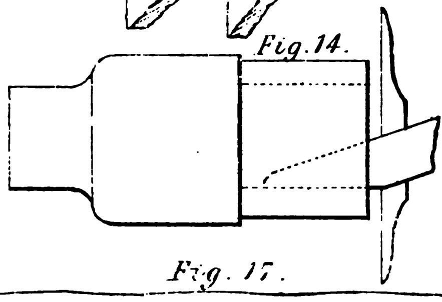


Fig. 7.

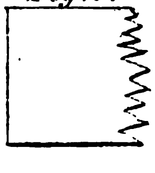


Fig. 17.

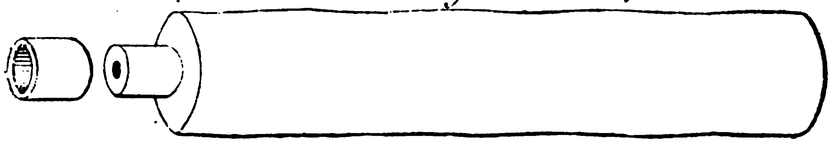


Fig. 18.

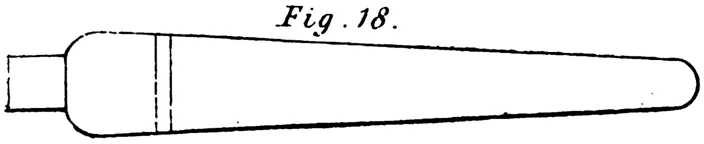
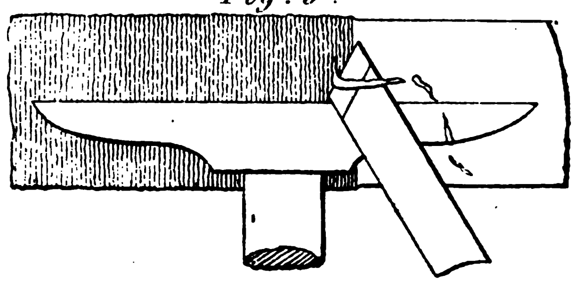


Fig. 9.



but for hard wood it may be a trifle less. But practically the same gouges are used indiscriminately for both woods, and the angle is always being rendered more obtuse by the process of sharpening. When newly ground the angle in the figure will be a good one. Prices of gouges —¼in. 7d., ⅜in. 8d., ½in. 9d , 1in. 1s. 3d.*

For side chisels we may select a large one, 1in., or 1¼in., and a ½in. and ¼in. And, by the way, though I mention these, a beginning may be made with one gouge and one chisel, say, a ½in. in each case, the others being added as required.

Grind the chisels to an angle of about 20deg. (Fig. 4). It should not be less—else they are liable to kick, and they should be kept thin and sharp (Fig. 5) for cutting down end grain with facility. If thick (Fig. 6) they "wobble" when cutting down across grain, with the result of leaving the work uneven (Fig. 7).

In grinding, some impart a slight amount of rounding to the cutting edge (Fig. 8). When turning, cut near the obtuse-angled end (Fig. 9), for if you get near to the opposite end, and slacken your grasp for a moment, the acute-angled corner will surely catch, and produce woful consequences. It is well to practise this side turning in preference to scraping, because the oblique cut is more like the action of a plane, and leaves the surface of the wood cleaner than does the tearing action of the scraping chisel. Yet two or three firmer chisels, say, 1½in, ¾in., and ⅜in., for truing up wooden face-chucks, and pieces of work of large diameter, and for recessing grooves, may be added with advantage. Prices of turning chisels—¼in. 6d., ½in. 7d., 1in. 11d.

Fig. 10 shows a round-nose tool, necessary in many instances where mouldings have to be finished, and indispensable also to the pattern-maker; ¾in., ½in., and ¼in. will be usful sizes. Of course these can only be used as scraping tools.

Side tools, Figs. 11 and 12, and diamond points, or parting tools, Fig. 13, are for turning, or rather finishing, the internal portions of rings (Fig. 14) or edges (Fig. 15) either inner or outer, which could not be got at by tools having less bevel. These, as well as the round-nosed tools, can be purchased; but they can be readily made, and will be quite as serviceable as the purchased ones, from worn out fine-cut flat files of different sizes. Grind off the greater portion of the cuts from their faces, and grind also the points to the required bevel or curve, as the case may be, and these will make excellent turning tools. You will be able to afford a greater variety by this means than if every tool had to be purchased. Always manage to utilise the old files in some way or another. Scrapers, screwdrivers, metal-turning tools, and I hardly know what besides, can be made from old files.

When purchased, tools are without handles, and though the ironmonger will supply you with the latter at about 2d. each, they may just as well be made as bought. Get some hard wood, almost any common wood, oak, ash, beech, birch, apple tree, &c., and saw into strips, some 11in. or 12in. long by 1½ square for the gouges and chisels, and others 8in. or 9in. long by 1½in. square for the scraping tools. Chop off the edges, start centres in ends with a gimlet, and run a cut in at one end with a tenon saw for the fork chuck. Get some brass tubing, ½in., ⅝in., ¾in. for different-sized tools, and cut off in lengths for ferruling. The neatest way to cut it off is this:—Say it is ½in. tubing. Get a piece of hard wood, not too long, say 5in. or 6in., and turn down to ½in., so that the tubing can be driven tightly over it by tapping with the hammer. When thus driven on, re-chuck the wood in the lathe, and cut off the ferrules with the point of a side chisel, or of a diamond point (Fig. 16). Tap out the wooden mandrel, file the burr from the inside of the ferrules, after which they are ready to go on their handles. Turn down one end of the wood intended for the handle—that end nearest the poppet—with calipers set to the inside diameter of the ferrule (Fig. 17), and drive the wood into the ferrule tight, opening the jaws of the vice wide enough for the edges of the ferrule to rest upon while doing so. Then replace in lathe and turn to shape, which may be either that of Fig. 18 or that of Fig 1, the latter being, in my opinion, preferable, as affording a larger grip for the hand. Bore the hole for the tool either with a gimlet or brace and bit, as straight as may be, sighting down gimlet and handle from time to time while boring. Open the hole out at the top with a taper shell bit, until the tool will drop in to within ¾in. or 1in. of its proper position, when the handle must be driven on over the shank with a hammer or mallet, holding the tool in a vice or against a block of hard wood while doing so. A couple of coats of shellac varnish given to the handles will improve their appearance and keep them clean.

Turning tools loose their edges very rapidly, and a quick fretting stone should be used for restoring them. A Charnley Forest stone (my favourite for ordinary tools) is hardly coarse enough for turning gouges. It may be used for the chisels, which require a finer edge; but for gouges a Grecian or a Washita stone is quicker in its action, or, even as I have sometimes seen, a piece of common slate will serve the purpose. Another reason why a special stone should be kept for the gouges is that they rapidly groove it out, and so render it useless for chisels and other tools having straight cutting edges. A slip of Charnley Forest will do for fretting the hollow portion of the gouge. Even that is not necessary when the tool is roughing down, since the revolving wood itself will knock off immediately the "burr" or "wire edge," which has been produced by sharpening the bevelled face.

The general subject of the grinding and sharpening of edge tools will, I think, be treated in a more connected and comprehensive fashion in a chapter specially devoted to it, than by sundry isolated remarks having no relation the one to the other. This I propose to do towards the conclusion of these articles.

NEW WATERPROOFING COMPOUNDS.

AMONGST new waterproofing compounds recently introduced, we notice the invention of Mr. W. Burnham, of Chicago, which has been patented in this country, and which is based on the peculiar properties of the sap of the mangrove-tree, known in the States of Columbia as Cativo. Mr. Burnham has discovered that, by combining this sap with caoutchouc in variable proportions, he is enabled to produce permanently elastic waterproof compounds. These compounds are capable of being made into waterproof varnishes by the use of the solvents and additional ingredients ordinarily employed in making so-called indiarubber or caoutchouc varnishes, and are also capable of conversion into products of greater or less hardness by the ordinary process of vulcanisation, either with or without the addition of the whiting, white lead, or other ingredients usually introduced into caoutchouc compounds. The so-called "cativo" is semi-solid at the ordinary temperature of the atmosphere, but becomes fluid at about 130° Fahrenheit. In preparing this material to serve as the base of the improved compound, it is preferably raised to a temperature slightly above that of boiling water for the purpose of diminishing the strength of its natural odour, and is then strained through a bag-filter to separate it from insoluble impurities. When strained and purified it exhibits a clear reddish-brown colour. In this condition it is mixed with caoutchouc, either by using appropriate solvents, such as bisulphide of carbon or mineral naphtha, or by the employment of hot kneading rolls, by means of which the mixture is effected mechanically. In the latter case, the temperature is elevated until the mixture acquires the desired degree of plasticity. The improved compound may be used as the base for a waterproof varnish, in which case it is preferable to effect the mixture by dissolving the cativo and caoutchouc, in any desired proportion (for example three parts of cativo to one of caoutchouc), in bisulphide of carbon, naphtha, or other solvent, to which may be added linseed oil, tar, or asphalte, or either of the ingredients ordinarily employed in the manufacture of varnishes from caoutchouc. When it is desired to produce a vulcanised product, the patentee prefers to effect the mixture of the cativo and caoutchouc mechanically by the use of the ordinary kneading rolls, by means of which he, at the same time, incorporates into the mixture the ingredients ordinarily employed in the formation of caoutchouc compounds preparatory to subjecting them to the ordinary processes of vulcanisation. By vulcanising the compound with, say, five per cent. of sulphur, he obtains a strong elastic product. For special purposes the proportion of sulphur may be largely increased, so that the product will acquire additional hardness. Metallic oxides, carbonates, or other solid substances may be mixed with the compound for increasing its weight or bulk, or for other purposes. For example, a product suitable for application to canvas may be made by using the following ingredients, in or about in the proportions named; that is to say, for example, cativo 23 parts, caoutchouc 23 parts, whiting 36 parts, white-lead 7 parts, litharge 5·5 parts, sulphur 5·5 parts. The vulcanisation of the mixture is effected by subjecting it to a temperature of about 275° Fahrenheit.

Another waterproofing compound which appears to be novel is that patented on behalf of M. Bellefroid, of Cureghem, Anderlecht, Belgium. It is described as an impermeable coating, and consists firstly of a solution of stearine pitch, one of the by-products of candle making, which pitch, in order to be used in the fabrication of the compound, must previously have been completely oxidised by exposure to the air. In order to complete this oxidisation the pitch must be spread out in very thin layers, and exposed to the outward atmosphere for a period of at least two years. This exposure is absolutely necessary, judging from experiments repeatedly made. The solution is afterwards effected in the following manner. A mixture consisting of 75 kilogrammes of stearine pitch, 15 kilogrammes of water, and 5 kilogrammes of caustic soda at about 35° to 36° is put into a boiler or vessel of any suitable shape, having a second or double bottom so as to allow of the removal of impurities which will settle at the bottom of the vessel. The mixture is boiled for 12 hours over a strong fire, after which [illegible] litres of water are added, and the boiling continued for another 12 hours. The solution thus obtained is then poured out in an open vessel, and left exposed to the open air for eight days, for the purpose of being clarified and enabling the impurities therein contained to settle at the bottom. The solution obtained according to the above process has the property of thorough impermeability.

THE "OTTO" GAS-ENGINE.

MESSRS. CROSSLEY BROS., Limited, of Manchester, have recently added an important improvement to their gas-engine. This consists of a self-starting apparatus, by means of which the engine can be put in motion by simply opening a valve.

The apparatus consists of a small receiver, into which the engine exhausts for a very short portion of its stroke the burnt gases which result from the ignition of the charge in the cylinder. These gases fill the receiver, and in the course of half a minute raise a pressure in it nearly corresponding to the pressure in the cylinder during the moment of ignition.

These stored burnt gases are admitted again to the cylinder at the moment of starting, by a very simple piece of mechanism, and thus put the engine in motion in much the same way as steam moves a steam-engine, thus saving the trouble of pulling the wheel round to get in the first charge. This little apparatus was patented three years ago by Messrs. Crossley. It may be applied to existing engines.

ON THE VALUE OF DIAPHRAGMS IN PHOTOGRAPHIC LENSES.*

MANY an amateur, on commencing landscape work, is troubled by the various stops applied to the lens he possesses not bearing any definite relation to the fixed aperture of the lens, so that even if he knows the rule to square the exposure for each decrease in size of the stop, he is still in trouble on account of the numbers on them not having any definite relation; and, further, if he tries to use another lens after having got used to his own he is rather worse off than before, for a time at least. All photographers know that different lenses possess different rapidities, but yet this difference is more apparent than real, the whole difference lying in the stops.

In order to define accurately the size of a diaphragm used in any lens, a formula is generally given for it, it being generally written as an italic "f" divided by some number; for example, $\frac{f}{1}$. This simply means, assuming that "f" means "focus," the length of the focus of the lens divided by some figure that will give the size of the stop.

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* Approximate prices may be of service to readers who have had little to do with the tool shops, bearing in mind that they will vary slightly with different manufacturers and local dealers. A respectable ironmonger will keep only the tools of approved makers, whose names are usually a guarantee of the excellence of their wares.

* By Dr. Scott, extracted from a paper read before the Photographic Society of Ireland.

Thus, if we have a lens of eight inches focus, and find by measurement that the largest stop be half an inch, on dividing the latter into the former we get 16 as a result. Now write this as $\frac{f}{16}$, and we have the exact relation of the stop to the focal length. If another stop measures quarter inch, the resulting fraction will stand $\frac{f}{32}$. By this simple means we see at once that the latter stop is one-half the size of the former, and that it will require four times the exposure. Again, should it be necessary to have two different lenses in use, as it may not always be possible to have them of the same class—a short focus symmetrical, and a long focus single landscape lens, for example—some means of comparing the rates of exposure should be at hand. In two such lenses at present in my possession I find that the full aperture of the single lens is $\frac{f}{13}$, while that of the symmetrical lens is $\frac{f}{16}$. On squaring these, the relation stands pretty near as 1 is to 1½, so that the latter lens requires an increase of exposure in that ratio. From this we see that all lenses possess the same rapidity, *provided the stops bear the same relation to the focus*; the great difference in the rapid lenses over the slow ones being that they can work with much larger aperture.

In order to equalise the various makers' lenses, the Photographic Society of Great Britain have recommended what is termed a "uniform system" of numbering the stops. They recommend that all the stops having the formula $\frac{}{4}$ be stamped with the figure 1, this being the largest aperture that it is at present possible to make, and every other stop with that number which would indicate the exposure in comparison with the standard $\frac{f}{4}$, without regard whether all the stops can be found in the lens or not. The figures would run thus:—

$\frac{f}{4}$	$\frac{f}{5\cdot6}$	$\frac{f}{8}$	$\frac{f}{11\cdot3}$	$\frac{f}{16}$	$\frac{f}{22\cdot6}$	$\frac{f}{32}$	$\frac{f}{45}$	$\frac{f}{64}$
1	2	4	8	16	32	64	128	256

The intermediate ones by calculated proportion. If this was carried out by all makers, no matter what lens we took up, the exact rapidity could be seen at a glance.

I calculate the formula of the various stops in the lens, and select three or four of those that bear a direct proportion to each other, so that the exposure may be, say, the middle stop four times the full aperture, and the small one four times the middle, and consequently sixteen times the full aperture.

Elevated Coral Reefs of Cuba.—Mr. W. O. Crosby (*Proc.* Bost. Soc. Nat. Hist.) describes the elevated coral reefs of Cuba, and from them draws inferences adverse to those drawn by Prof. A. Agassiz from examination of the Florida reefs. Four coral terraces extend, with slight interruptions, round the entire Island of Cuba. In the western part of the island they are the predominating formation, and are well preserved on the summits of the highest hills, but, further east, erosion has been more rapid. The lowest terrace on the northern side of the island rises 30ft., the second rises abruptly 200ft. to 250ft. above it, the third is about 500ft. high, and the fourth has a height of probably not less than 800ft. near Baracoa. Five miles west of Baracoa 1,000ft. of the upper part of a mountain is reef limestone, and originally the formation must have been 2,000ft. thick. The thickness of the reefs here and upon the Island of Jamaica, where the elevated reefs reach a thickness of 2,000ft., is considered by Mr. Crosby to prove that they were formed in shallow water during a period of slow subsidence, according to the theory of Darwin. There does not appear to be any reason to doubt Mr. Crosby's conclusions in this case, neither does there appear to be any reason to doubt those of Prof. Agassiz in that of the Florida reefs. The latter authority does not endeavour to set aside the theory of Darwin; but to show that in some cases, at least, coral reefs are but the summit of an elevation formed by other agencies. In cases of subsidence the reefs are thick, while in regions of elevation, as in Florida, the coral reef is but a thin crust topping a bank of deposited matter.—*American Naturalist.*

Waterproof Luminous Paper.—For preparing a waterproof paper which will shine in the dark, the *Papier Zeitung* gives the following mixture: 40 parts paper stock, 10 parts phosphorescent powder, 10 parts water, 1 part gelatine, and 1 part bichromate of potash.

SCIENTIFIC NEWS.

THE death of Dr. Schmidt, the director of the observatory at Athens, has been announced in the newspapers in connection with the public funeral at which the King and Queen of Greece attended. Johann Friedrich Julius Schmidt was born at Eutin, Lubeck, in 1825, and after studying under Rümker at Hamburg, went successively to the observatories at Bilk, Bonn, and Olmutz. He was appointed director of the Athens Observatory in 1858, and for 25 years, with inadequate means, he contributed greatly to the progress of astronomy by his observations of comets, variable stars, and meteoroids. His famous Map of the Moon, which may be described as his *magnum opus*, was commenced in 1843, and for thirty years Schmidt added drawing to drawing, until in 1878 the map was published by the German Government, on the scale of seventy-five inches to the diameter of the moon. Dr. Schmidt was elected an associate of the R.A.S. in 1874.

We have also to announce the death of Count Th. du Moncel, the famous French electrician, which occurred suddenly at the end of last week. His works on the telegraph, the telephone, electric light, &c., are very popular in France, and one, if not more, have been translated into English. The Count du Moncel was latterly the editor of *La Lumière Electrique.*

Dr. J. Palisa, with the assistance of some very high and notable personages in Vienna, has found names for his three anonymous small planets. No. 220 he proposes to call Stephania, 221 Eos, and 222 Lucia.

Mr. C. Homersham, C.E., has been engaged for some time in boring for water at Richmond, Surrey, and although he has not yet been successful, the work accomplished is of very great interest. The boring has reached a depth of over 1,300ft., which is stated to be lower than any well in the London basin, and according to Prof. Judd, to whose care the cores have been intrusted, pebbles of coal-measure sandstone and fragments of anthracite have been found in a series of Oolitic strata lying beneath the gault. These Oolitic strata, which are found at a depth of about 1,150ft., consist mainly of limestones, but include a thin band of clay peculiarly rich in fossils of the age of the great Oolite. They are 87ft. thick, and form a new discovery in the London basin.

The Royal Society has appointed a committee to collect the various accounts of the volcanic eruptions at Krakatoa and the attendant phenomena.

Prof. Davidson, of San Francisco, has received a report of the volcanic eruption in Alaska last October. Dense masses of smoke and flame were observed to shoot up from Mount St. Augustine, vast quantities of pumice stone and dust fell, and the mount was found to have split into two, the northern portion sinking to the level of the surrounding hills, while a new island arose in the passage between Chernaboura Island and the mainland. The whole peninsula seems to have shared in the display of the subterranean energy, for not only was Ilianna fully at work, but two extinct volcanoes resumed their offices by sending up clouds of dust and stones accompanied by volumes of smoke.

A Government Bill has been introduced by Mr. Courtney for conferring further powers on the Commissioners of Public Works in Ireland, enabling them to acquire land for the purposes of the Act of 1877, which relates to the erection of a science and art museum, and the establishment of a national library in Dublin.

The Council of the Royal Meteorological Society purpose holding an exhibition of thermometers on March 19, when they will be glad to include any new meteorological apparatus invented since March last, as well as photographs and drawings of interest to meteorologists.

The Hotel Dieu, the largest hospital in Paris, is about to try Edison lamps in some of the wards.

It is stated that M. D. Monnier, with a Skrivanoff battery, weighing a trifle more than 3½oz., recently obtained during one hour an E.M.F. of 1·45 volt, and a current of 1 ampère. We described this cell on p. 82, Vol. XXXVI.

The case of Daniel Drawbaugh, as an inventor of the telephone, seems to be a very strong one. He has nearly one hundred and fifty witnesses to prove that they had seen and tried his telephones long before Bell's were heard of. It appears that Drawbaugh invented a practical instrument in 1866, and by 1874 had produced several devices, some of them as perfect as any in use at the present time.

In the course of one year, in the Municipal Laboratory of Paris, 3,361 samples of wine were examined, and more than one-half found to be bad, while 202 were positively dangerous. Of 1,037 samples of milk and cream, 542 were bad, and of 71 samples of preserves (fruit), no fewer than 25 were found to be dangerous. Of 92 samples of water, 63 were pronounced dangerous.

Preparations are being made at the Johns Hopkins University, Baltimore, for an elaborate series of tests to determine the exact value of the ohm.

Professor Hull, who has returned with his party, brings with him materials for the construction of a geological map of the Holy Land, in advance of anything hitherto attempted. He has traced the ancient margin of the Gulfs of Suez and Akabah to a height of 200ft. above their present level, so that the whole country has been submerged to that extent, and has been gradually rising. As one most interesting result of this rise, the professor is of opinion that at the time of the Exodus there was a continuous connection of the Mediterranean and the Red Sea. As regards the Dead Sea, he has discovered that it formerly stood at an elevation of 1,400ft. above its present level—that is to say, 150ft. above the level of the Mediterranean. The history of the gradual lowering of the waters will form a special feature in Professor Hull's forthcoming report.

The death is announced of Herr Hoffmeyer, the head of the Meteorological Institute of Copenhagen.

A remarkable case of "healing by faith" reported to have occurred near Dudley. A young woman, of Brockmoor, has been confined to bed for the past twenty months, suffering from paralysis of the muscles of the neck, and unable to raise her head. On Monday last she was visited by several members of the Salvation Army, who prayed with her, and it is stated that whilst they were praying the girl called out "God is healing me!" and sat up erect at once without any assistance. Both the girl and her mother believe that the change was effected by the power of prayer. The recently-exposed fraud at Whitstable indisposes one to consider these cases very seriously.

New Determination of the Ohm.—Preparations are now being made upon an elaborate scale at the Johns Hopkins University, at Baltimore, under the direction of Prof. Rowland, for the exact determination of the value of the ohm. Two principal methods will be employed. First, the resistance will be found by means of the mechanical equivalent of heat. The apparatus used by Prof. Rowland, in his well-known work on that subject, has been set up for this purpose. It is proposed to heat a non-conducting fluid, such as alcohol or turpentine, by heat developed in a conductor whose extremities are kept at a known difference of potential. The same temperature will then be reproduced under like circumstances by mechanical means. The resistance of the conductor will thus be determined directly from the work equivalent of the heat developed in the conductor. The second method to be used is that of Kirchoff, as modified by Rowland in his determination of the ohm in 1876: most of the instruments will, however, be new. If time permits, the earth-conductor method of Weber will also be used. Fifty Planté cells charged by a small dynamo machine will supply the electricity in the calorimetric method. For measuring large currents, an electro-dynamometer has been constructed with the Helmholtz arrangement of two large coils and a single small suspended coil.

M. REYNIER has suggested a modification of his maximum cell to serve as a standard of electromotive force—namely, a cell having a large copper electrode, and a very small amalgamated zinc electrode, immersed in a solution of sea salt. According to M. Reynier, this battery has an electromotive force 0·82 volts, and maintains this value within 1 per cent. even when the circuit was passed for two hours through a resistance of 820 ohms. M. Reynier prefers this combination to one containing sulphate of zinc in solution, because of the liability of the latter salt to contain free acid.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 81, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—Montaigne's Essays.

[illegible]—PICARD—PLATO.

[illegible]—Mr. [illegible] sketch on p. [illegible] evidently shows that the [illegible] which I saw east of [illegible] p. [illegible] is that which he calls [illegible], and not as I supposed [illegible]. I am surprised that I did not see [illegible] as he has found [illegible].

Mr. [illegible] asks, p. [illegible], which of the ridges mentioned in the [illegible] for Feb. [illegible] I meant when I said that the ridge [illegible] between Picard and Peirce, in his [illegible] on p. [illegible] might be the same as the one mentioned there.

It was the ridge mentioned as being between Picard and Peirce that I referred to. Though the two descriptions are not exactly the same, there seemed likely to be a connection between the observations—that perhaps it was the same ridge seen under different illuminations.

Since my former reply to Mr. Gemmill I had a [illegible] view on Nov. [illegible] of the valley [illegible] Plato which I there mentioned (p. [illegible]), [illegible] to be perhaps its southern extremity. It is a broad and shallow valley, tapering to its southern end, and extending northwards for a long distance. It is bounded on either side by ranges of hills. I should like to have sent my drawing of it, but the view was so unusually fine, and my efforts to represent it so feeble, that I fear it would not "pay" for the trouble of printing.

Mr. Gemmill must excuse me from entering into further discussion respecting the study of selenography. As it appears to be simply a question of words or opinions between himself and me, there does not seem anything to be gained by doing so, and it is not easy to make time to do more than note a few notes of things observed. M. A.

ASCERTAINING THE MOON'S AGE ON ANY DAY OF THE MONTH.

[illegible]—In your issue of Feb. [illegible], of 188[illegible], I observe that Mr. James Pearce, &c., submits, among other curious problems, one for "ascertaining the moon's age on any day of the month, in any year in the past, present, or future, &c."

I am sorry to have to question any statement from so eminent an "authority," but the rule given does not work. I have made the experiment for every month in the century, and not in a single instance is the result as it should be. The No. [illegible] which is to be added—is not this the Epact? And if so, should it not vary for every month, and is no notice to be taken for leap years?

Take the present day, Jan. [illegible], 1884.

[illegible]

[illegible] = [illegible] = [illegible]
[illegible] century = [illegible]
= [illegible]
Months March to January .... [illegible]
Day of month .... [illegible]
Add No. [illegible] .... [illegible]
[illegible]
The century .... [illegible]
[illegible]

[illegible] days old, whereas it is but three days old.

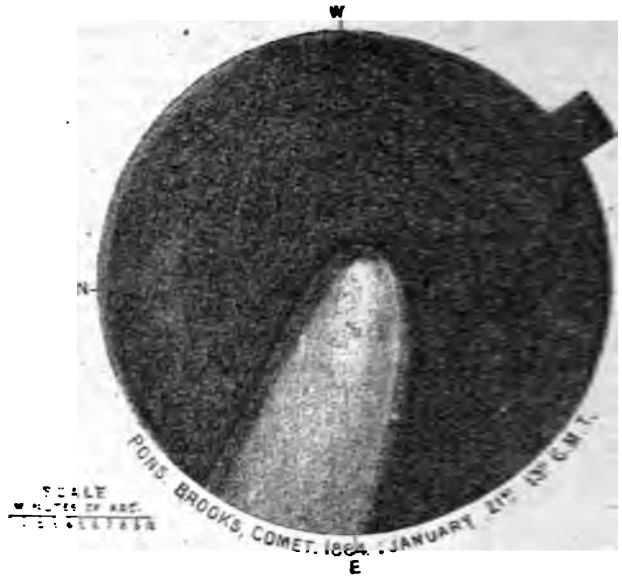
Major Trasseweather.

[illegible] Observatory, Tierra del Fuego, [illegible], Jan. [illegible], 1884.

COMET PONS-BROOKS.

[illegible]—I [illegible] sketch of comet Pons-Brooks as drawn by Mr. [illegible] on the evening of Jan. [illegible], 1884, with [illegible] refractor, power [illegible].

The [illegible] letter of Mr. Edwin Holmes ([illegible], page [illegible]), might perhaps well be ignored. Yet, for his satisfaction, I will state that the highest power eyepiece used in connection with our [illegible] refractor, as given by the maker, magnifies [illegible] diameters, and when used with the Barlow lens, which I was informed doubled the power of every eyepiece, produces a magnifying power of 1,024 as stated. A simple case of multiplying by two—an arithmetical feat which, I presume, Mr. Holmes is doubtless capable of performing.


W
N
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SCALE
MINUTES OF ARC
PONS BROOKS, COMET. 1884. JANUARY 21st 13h G.M.T.

With reference to Mr. Holmes's latter criticism, I simply reiterate that there are no features (barring those heretofore named) in Trouvelot's drawing of the planet Saturn which cannot be seen, and *well seen*, in our 6¼in. refractor under favourable atmospheric conditions, such as existed upon the night in question.

It is scarcely necessary for Mr. Holmes to quote Dr. Kitchener, or any other authority, to convince anyone having had twenty-four hours' experience with a telescope, of the uselessness of employing such enormous magnifiers except for purposes of experiment.

This power was employed solely for such purpose of experiment, and the result communicated to you, Sir, with other intent than that of a hoax.

W. C. Gurley.

Marietta Observatory, Jan. 26th.

STAR COLOURS AND NAKED-EYE OBSERVATIONS.

[illegible].]—I had expected to see something from the pen of our good friend, the Rev. T. W. Webb, in response to the appeal by Mr. Gemmill (letter [illegible], p. 495); but, pending this, I will endeavour to give the result of my own limited experience. With respect to the employment of an opera-glass for the observation of star colours, I fear its range is too limited to be of much service. For moderately bright stars, I should recommend a refractor of about 4in. aperture, in which the over-correction of the o.g. should be very slightly seen; and, in my opinion, Wray's o.g.'s most nearly fulfil this condition. The faintest stars are more suited to a reflector, which might be 6in. or upwards in aperture.

As to magnifying power, a *good* Huyghenian eyepiece of [illegible] to 120 diameters is as useful as any, although some of the achromatic eyepieces are very fine for this class of work. Very often, in the case of double stars, a slight displacement of the image from the focal point will assist in the estimation of the separate colours. A bar in the field of view may also be employed to hide one of the components whilst viewing the other. In all cases, the star under examination should be kept near the centre of the field, as the edges are not usually achromatic. The proper description of star colours is a difficult task, from want of comparison with a definite standard. A small spectroscope, with a Swan incandescent lamp as a source of light, might be readily attached to the telescope, near eyepiece, for purposes of comparison; but, again, there are scores of star tints not to be found in the spectrum at all. I freely acknowledge that my own attempts at describing star colours are very unsatisfactory to myself; and I should feel extremely thankful could I see a really trustworthy and workable method, whereby these results might be secured without that personal equation which is so detrimental; but at present I do not. One serious source of error lies in the artificial light used to register the observations by. Gas and oils are more or less yellow; petroleum is whiter, but its odour unpleasant, and apt to give one a headache. The electric incandescent lamp is probably the best, and certainly the most convenient, form of light for the amateur's use. Whatever be the light, when going from it to the telescope, a brief rest should be given to the eye before applying it to the eyepiece.

Variable stars are, perhaps, the most useful objects to examine with the naked eye or opera-glass, and Mr. Gemmill himself is quite competent to advise on these.

Hastings, Feb. 15. **W. S. Franks.**

THE EFFECT OF MIST AND HALOS ON DEFINITION—JUPITER.

[22361.]—I may supplement my remark, that "F.R.A.S." confirms, that mist of a certain kind improves the definition of Jupiter, by the following fact which I have also noticed, and particularly so on December 12, 1883, and January 8 of this year. On both nights there was a mist and prismatic halo round the moon, and on January 8, while the mist was passing over the moon, the halo being present, every detail on her surface stood out sharply and with the greatest distinctness; but the next minute mist of a different kind passed across, and though it did not appear to the eye to be at all thicker than the first mist, yet it completely blotted out all detail. The effect was curious, as the swiftly passing mist thus changed from one kind to the other every minute or two, though with no perceptible difference in appearance; and one moment definition was perfect, while the next nothing but the largest features could be seen, and those considerably dulled. On December 12 a star shone brightly through the violet part of the halo, and dimmed through the orange, as the halo waved from side to side. The whole sky was covered with thick misty clouds, and when a mist followed the halo across the moon and star, though it appeared no thicker than the mist of the halo, yet the star could not be seen through it. Thus we see that two mists, with no perceptible difference to the eye, may differ considerably in thickness or in absorbing power. While mentioning haloes, I will remark that I have seen it stated that prismatic haloes are very rare. This I do not think is so. I have made a habit for some years past of putting down all the haloes I have seen of every kind, and prismatic ones I very often see through the nights. I have noticed, however, that they are very rare before 11 or 12 p.m. Some of the rapidly shifting ones are of great beauty. I have sometimes thought of sending my catalogue of haloes to the English Mechanic, but I suppose it would not be of any use. If, however, any one thinks it would be, I will send it; it dates from 1877 until now, with a few in 1860 and 1861.

Did any one observe on February 11, at 14h., that the southern half of Jupiter, from the south equatorial belt to the pole, was of a greenish-yellow colour? It was very conspicuous to me; but was, I suppose, due to some atmospheric cause.

M. A.

MEASURING POWER OF TELESCOP

[22362.]—Every method yet devised for the purpose seems to be open to some objection. The plan of setting up marks at 100 yards or so fails for the simple reason that the power on an object at 100 yards is very different to the power on a star, while dynameters differ in results, and with a high power it is difficult to judge exactly when the small circle of light just touches the sides of the tapering slot. My object, however, is not to point out faults, but to suggest a method which requires no special apparatus and no special training, and yet is reliable, accurate, and easy.

Take the eyepiece whose power is desired in front of a window, and look through it. A circle of light will be visible, which is the field of view. Step back or forward until this circle of light just exactly apparently equal to the clear opening of the window. Measure the distance from centre of window to stop of eyepiece, and measure the clear opening of window. Draw a line on paper as many inches in length as window is feet in width, and set up a perpendicular from centre in same proportion to distance from window. Join the ends of first line and perpendicular, and measure the angle at vertex. This can be obtained by calculation as easily, and is the angular field of view. Now put the eyepiece in the telescope, and time the passage of an equatorial star across the field. Turn this into seconds of arc, giving thus the angular diameter of actual field. Divide the first obtained angular field of eyepiece by this actual field in sky, and the power of the eyepiece on the o.g. or mirror in use is obtained in a moment. This is much simpler in practice than it looks on paper. Instance, I find field of eyepiece in my possession 25° apparently. An equatorial star passes through field in 25 seconds. This is 375″ of arc; 25° = 126,000″, and this divided by 375 gives 336 for the power. **E. Holmes.**

GLACIERS AND THEIR MOVEMENT.—II.

[22363.]—In the English Mechanic for Dec. 28th of last year (letter 22185), I gave a rough outline of some of the many theories which have been adduced by eminent travellers and observers on the subject of the "movement of glaciers." To those I would now add but one more, thus to show how hard a problem it is, and how much more there yet is to be observed before we can feel at all sure that any explanation offered is the true one, and to the full really gives a complete and final explanation of the phenomena. To the eminent authorities already cited, I would now add that of M. Rendu, Bishop of Annécy. The Bishop is here a great authority, and he has, by force of original researches, which makes all he says on this subject well worthy of study, thrown much light on it. Professor Tyndall says of him that he was of those who had an extraordinary faculty of observation, and an intuitive power concerning things yet untouched by experiment, belonging but to the few. This observer compares the glacier to a river, and says there is a resemblance so complete between rivers and glaciers that it is impossible to find in a river any circumstance which does not exist in a glacier—*e.g.*, between the Mer de Glace and the river nearest to it, the resemblance is complete. By this theory it is therefore evident that should the snow which feeds the glacier from any cause cease to fall, the glacier would in time nevertheless, empty itself from its bed, and leave it dry—as flowing water would do. But will those who have observed and thought about that difficult problem admit this as a sufficient explanation of glacier movement? M. Rendu calculated, it may be here added, that about *five feet* of ice is added each year to an Alpine glacier, and that this would make Mont Blanc 400ft. higher in each century, and 4,000ft. higher in a thousand years.

But the sole hint that the Bishop has thrown out as to the *cause* of the glacier movement is this: he says that, notwithstanding the hardness of the ice, it can but support a given pressure, without either breaking or being squeezed out; and thus it is, as he puts it, that the movement of the whole mass, or masses, of matter forming the glacier, follow of necessity. These theories are, it must be allowed, not a little ingenious; but they would certainly seem to be insufficient to fully account for glacier movement. And it is this which has led me to venture on yet one more attempt at an explanation of the puzzle of it; and I have been led to this partly by the study of one or two very simple experiments, and partly by the accidental observation of a curious fact in a not-distant snowstorm. These experiments and observations may be perhaps familiar to some; but they will bear repetition, and will at least be of interest to the traveller and glacier student. All know, or may by observation know, the look of, and how the sand falls and heaps itself up in a common hourglass. The sand does not level itself as it falls as a liquid would do, but assumes a conical form, the sides of which take an angle of about 35°. The same, of course, follows if fine sand be made to fall from a funnel on to a flat horizontal table. Any height of cone may thus be reached. Now, if this horizontal table be raised at one end, and made to form, in miniature, a mountain slope, say, to an angle of 30° or 40°, and then towards the upper end of it a cone of sand be gradually formed as above, it will be found that the dip of the incline does not alter the conditions of the experiment further than to make the lower slope of the cone of sand the longest and the upper one the shortest. However much the cone of sand may be added to, there is no tendency in it, as a mass, to slide down the incline until the incline, being made by degrees steeper and steeper, the cone of sand at last, all of it together, tumbles down the slope in a confused heap by sheer force of gravity, like a snow avalanche or a heap of rock débris down a mountain side. In no case, certainly, does sand or débris, or fine dry snow, as it falls and exists on the top of a snowclad mountain, come down into the valley as a glacier does. It falls, but as an avalanche falls, not as a river flows.

But now take what is termed a "viscous" substance—a semi-fluid, such as tar, or what is better for experiments on a small scale, common thick treacle, and what is the result if we repeat the above sand-heap experiments? The whole process and result is different. This "viscous" or semi-fluid matter cannot be piled up into a conical heap as sand or gravel; each additional quantity, as it comes from the source of supply, sinks into the mass as it spreads out in a circular form on the level table. Each additional quantity, instead of piling itself up in a conical form as the sand does, sinks into the mass beneath, and in doing so forces out the matter round it and on which it falls, and thus enlarges the circle of it. Now, if this same experiment be repeated on an inclined plane, as in the above experiment with the sand, the result will be found most curious and instructive, and will, perchance, guide to an apprehension of the primary cause of glacier motion. This "viscous" mass, as it accumulates, does not on this sloping surface, as on the level one, spread itself out into a circular form, but begins, as might be expected, to run slowly down the inclined plane in a long and elliptical form by mere force of gravity, and more or less rapidly according to the steepness of the incline. Suppose the angle of this incline or valley to be, say, 30°, observe the rate at which the viscous matter flows, the supply continuing regularly from the funnel at the top of the incline. Now lower the inclined plane to an angle of 10°, the same supply still continuing, and the result will be a diminished rate of speed, and a more sluggish flow of the viscous matter, whatever that may be, but without other change. This experiment may be usefully varied by trying different angles of slope.

But now again change the conditions of the experiment, and stop the supply of fresh matter from the funnel at the top of the incline, and the result is a little surprising: the flow of this model glacier almost wholly ceases; indeed, if the surface of the incline be at all rough, it stops altogether, the weight or gravity of the mass not being—by itself and alone—sufficient to urge it down the slight incline. Thus, as it has been contended so strenuously, the force of gravity alone is not sufficient to urge the mass of a glacier down a slightly inclined valley, whatever it may do down a steep incline. But all else remaining as before, again allow the supply of viscous matter to pour down on the head or source of this miniature glacier, and the flow, however slow it may be, immediately recommences down the whole length of the stream, and this it does, not only by the fact of the fresh supply flowing down upon it, but by the *pressure* or the *impetus* the fall of it thus acting on the whole mass gives it, and thus forcing it slowly downwards. This is a most instructive and suggestive experiment, and needing repetition on a large scale, and with different substances. It would seem to point to the *origin* of glacier motion, and to indicate how it really is that a glacier moves, and how far gravity or the weight of the glacier mass acts in drawing it down the incline of the mountain slope, however slight that may be. This experiment may be varied in a great variety of ways; but, however varied, the results are invariably the same, all tending to prove that the force which moves the ice glacier downwards and forwards is the constant pressure of the—ever being added to—great ice and snow "reservoir," as M. Rendu terms it, at the mountain top, and the *striking* force of the snowfalls. It is to be observed, and it must be borne well in mind, that a glacier, whatever the cause may be, flows as a viscous stream of matter—flowing, spreading, narrowing, and then widening, and again narrowing and bending, just as a viscous substance—*e.g.*, tar—is found to do, or as melted lava does down a volcano slope. In the illustration as above cited, we have supposed that the ever-renewed supply from the head of the glacier comes from a single point of supply, as from the mouth of a funnel; but precisely the same result comes from a like supply if split up into a number of small streams, as from the mouth of a watering-pot, with a number of separated small holes together acting like a wide-spread shower of viscous rain or snow. So striking is this experiment, especially if performed with different thicknesses of "viscous" substance, and with different inclines, representative of different slopes of the mountain masses, that it is all but impossible to do otherwise than to admit the enormous power exerted, not alone by the pressure, but by the *striking* force of the snowfalls and the ever-accumulating masses of matter—*i.e.*, of snow and ice at the glacier head at the "reservoir" glacier. Indeed, to go to the mountain top itself to the head of the glacier as to that of the Glacier des Bois, where is to be found a marvellous "sea of ice," as it has been described, and where the surface is horizontal, or nearly so. Here there is a constant advance of some 40ft. per year of the snow from, as I interpret it, the simple pressure of the constant *snow-fall* above it—a singular illustration on a gigantic scale of how these wonderful forces in nature act, and how simple at times is the cause of so much that is obscure.

I would add yet another illustration, and it is instructive, as coming from a quarter of the world out of the ordinary routes. On reaching the middle of the La, or Pass, on the way to the glacial lake, at the summit of it, says Mr. Wilson, it becomes at once apparent where its sea of ice comes from. On every side is to be seen the steep slopes of snow, or "nivé," with immense beds of snow overhanging them. A dazzling sheet of unbroken snow rises up for more than a thousand feet at a steep incline to vast over-hanging walls of what may be termed "stratified nivé," and from which huge masses, or fragments, every now and then come down with loud and thundering noises like the shattering into fragments of the very mountain itself. A huge cataract of snow and ice is forced down and over the edge of the incline, or table, on which it accumulates by the continual pressure of the snow above. This "glacier flow" is to be seen on the higher peaks of the Himalayas, where the glaciers are of enormous thickness and width, and by the side of which the Alpine glaciers and heights are but small, indeed, in comparison, huge and impressive as they are. Mr. Andrew Wilson, who traversed this "abode of snow," it is useful to observe, would seem to have come to the conclusion that the "heat of the sun" is the power which moves the glacier mass, and causes it to "creep down" the mountain hollows and valleys. If this be so, how, it may be asked, does the heat *act* so as to become a propelling or a dragging power? For that is, indeed, the problem.

I have thus ventured to indicate, or rather to hint at, the primary cause of "glacier motion," in the hope that many who visit year after year Alpine regions, where the phenomena may always be observed, will follow up the curious inquiry. It is at all times found advantageous to look at such phenomena with a theory of some sort—a plausible one, and one which at least seems to account for them—rather than to see and have none at all. I think that by dint of patience in looking at, and by attentively studying, the upper glaciers, their mode of movement might, in a degree, soon become visible. But, be this how it may, there can be but little doubt that many a crude and haphazard conjecture has proved eventually to herald in the advance of a great scientific truth—in this instance of the *cause* of glacier motion. Even an insufficient cause, or one acting only partially, may yet lead to a complete and comprehensive solution of the problem. It may indeed be true that not a single snowflake or a single drop of rain falls on to the summit of a snowclad mountain, or on to the slowly creeping glacier, which does not, in the very act of falling and striking it, as well as by its gravitating force, help to move downwards the vast, and as it looks, immovable mass and masses of ice and snow.

C. B. A.

THE INTERNATIONAL INSTITUTE FOR PRESERVING AND PERFECTING WEIGHTS AND MEASURES.

[22364.]—I fear that the hope expressed by your correspondent, "F.R.A.S.," in letter 23331, that under the auspices of the above Institute, accurate measures of the Great Pyramid will be made "by men who have no theory to support," is somewhat too sanguine. In the library of the Royal Astronomical Society is a copy of Vol. I., No. 4, of "The International Standard: a Magazine devoted to the Preservation and Perfection of the Anglo-Saxon Weights and Measures, and the Discussion and Dissemination of the Wisdom contained in the Great Pyramid of Jeezeh. Published by the International Institute for Preserving and Perfecting Weights and Measures." Judging from its contents, one would scarcely suppose the Institute to have "no theory to support."

The number contains, among other articles, a paper, proving to its author's entire satisfaction that certain chambers in the Pyramid give a clue to the Solar system of the ancients, the dimensions of the chambers representing the extent in the heavens of certain zodiacal constellations; a paper on the "Buried Cubit," showing that the British yard is everywhere present in the pyramid measurements, thus giving "a special identification of the British with the Lost House of Israel"; and a wild rhapsody on "Zechariah's visions of the Pyramid cap-stone, and of the wicked measures." The magazine closes with an "Inquirers' Club," in which is the horoscope of the late President Garfield, noteworthy for the fact that the President apparently did not live *quite* long enough to satisfy theory; but that "it will always be a matter of conjecture among students of astrology whether or not he would have reached this point if decisive steps had been taken immediately after the shooting, and a removal made to a locality designated by Jupiter in Aquarius." So the predictions of the stars may be falsified by the mistakes of our physicians—an important admission!

"F.R.A.S." is right on one point: the Institute is an uncompromising foe to the metric system: here the "Standard" gives no uncertain sound. I subjoin one verse from a charming poetical effusion which adorns its pages, "A pint's a pound the world around":—

"Then down with every 'metric' scheme
Taught by the foreign school,
We'll worship still our *Fathers'* God!
And keep our Fathers' '*rule*'!
A perfect inch, a perfect pint,
The Anglo's honest pound,
Shall hold their place upon the earth,
Till time's last trump shall sound!"

W. H. W.

A HAND-WARMER FOR PIANISTS.

[22365.]—I must apologise for not replying earlier to letter 22309 of Mr. W. Henley Richmond in the "E. M." of 1st inst. My hand-warmer is fixed to the piano by means of two small pieces of bent band-iron screwed under the keyboard, just above the knees. Two irons projecting from the warmer slide into these pieces, and the apparatus can thus be adjusted or removed *instantly*, and cannot be displaced by any knock given it while playing. When the warmer is not required it can be removed, and as the two pieces of band-iron are quite out of sight no trace whatever of the fixing can be seen.

It would be a very long and difficult task for me to give full instructions for making my hand-warmer, and would answer no purpose, as it would be much more advantageous and cheaper for any person wishing to have one to get it made by the maker of my own, whose name I will be happy to send to anyone advertising address in the "E. M." for the purpose. **W. Ritchie.**

PUMPING BY SUCTION.

[22366.]—"Essar," on p. 499, wishes "D. L." to explain whether the water will flow up the pump barrel when the pump fittings fail to suck either air or water.

What "D. L." meant, perhaps, was this. In the act of withdrawing the air or water from the barrel, it leaves an empty space. Now an empty space is a vacuum, and can exert no power to resist the pressure of the atmosphere, so that air would rush up to destroy the vacuum: as the suction pipe is in water, the latter has to go, but under pressure of the atmosphere.

If water were to go up into a pump barrel without it having been first emptied, would not water be able to rise from the sea?

I should like "D. L." to say what is suction, if it is not the weight of the atmosphere acting on the surface of the water, and forcing it into a vacuum being created in a pipe or pump.

J. P.

[22367.]—What is the meaning of all the scientific (?) indignation evinced by "Egstow" and others in connection with the word "suction" as applied to a pump? I suppose it will be allowed that one is correct in saying a baby *sucks*; if so, in what way does that action differ from that of a common pump? The child takes the nipple in its mouth, creates a partial vacuum, and the pressure of the atmosphere on the surface of the breast causes the milk to rise into the small ducts in the nipple, and overflow into the child's mouth. Substitute vacuum produced by pump bucket for mouth, pipe for nipple, and water surface for surface of breast, and where is the difference? But "Egstow" speaks of "that feat" of suction. What in the name of common sense does he suppose suction consists in? **W. A. G.**

[22368.]—I note a paragraph under the above heading on p. 453 of your issue of January 25th last.

Assuming it to be a fact that the arrangement therein referred to does enable the suction pump to raise the water 37ft., the explanation of the case is not difficult.

The inventor of the arrangement is not the first who has discovered it, or attempted to deceive the public by its means.

In 1766, at Seville, a tinman undertook to pump from a well 60ft. deep, by a common pump, making the sucker play within 50ft. of the water. As he failed to pump the water, in despair at his want of success, he dashed his hammer against the pipe, by this act he made a small opening about 10ft. above the water, and to his great pleasure the water instantly ascended and was discharged at the spout. A surgeon of Rouen repeated the experiment with his pump; he bored a small hole in the suction pipe 10ft. above the water, to which he attached a cock; when it was open the water could be raised 35ft., instead of 30ft. when it was shut.

One Langden, about the year 1797, invented an "hydraulic machine" by which water was raised 42ft. through leaky tin pipes. Of course, the invention could raise water no higher than in the common pump, unless there was a perforation in suction pipe.

The explanation of these cases is simple, and fully confirms the theory of atmospheric pressure. The air in entering the suction pipes at the small hole became mixed with the water, which, therefore, was raised in disjointed portions or in the form of thick rain, instead of being carried up in a solid column. This mixture being much lighter than water alone, the atmospheric pressure could support a longer column of it.

If the admission of air is properly arranged, there is no difficulty in raising the compound fluid from one to two hundred feet by a common pump.

There is, therefore, not the slightest doubt but that the air pump referred to is raising a compound fluid of air and water, and the only question remaining to be answered is (and which can be only ascertained by careful examination), How the air is admitted into the suction pipe? **W. W. W.**

Newcastle-on-Tyne, Feb. 18th.

[22369.]—On the contrary, Mr. "Egstow" (p. 521), you have found the "other side" by the discovery that Ganot "used the term technically." In the "84th year of the 19th-century," it is absurd to talk about the "miscalled suction-pump," when the term is definite, distinct, and well understood—at least as well understood as sunset and sunrise. Nuttall, in his dictionary, which does not pretend to be scientific, says (I quote from memory), "Suction pump: the common pump, in which the water is raised by atmospheric pressure." It is simply a libel on pumpmakers to say they do not know that simple fact. But that is only a detail. I should like to hear what Mr. Davies or anybody else has to say about the arrangement described on p. 453. Perhaps "Egstow" will help to explain how the water is lifted 37ft., and not quibble about the application of such terms as "suck" and "suction." **Essar.**

INGROWING TOENAIL.

[22370.]—"U. C. S." (22329) puts forth a very plausible idea: but has he every tried it? Having suffered from this complaint myself, and getting no cure from the scraping, I write to say so. I also tried cutting a V-shaped piece out of the centre of the nail at someone's suggestion, but it did no good. I put a plug of cotton-wool under the offending corner to keep it out of the flesh, still it grew. I had the nail cut out and again it grew. Lastly, I took to wearing shoes with broad toes, which allowed them (the toes) freedom and no pressure, and have now been free from it a long time. If my large toes feel ever uncomfortable, I cut the nails, and am eased at once. This ingrowing nail is due, I believe, to our narrow-pointed shoes, which compress the toes together too much.

T. R. Allison, L.R.C.P., etc.

BEE-KEEPING.

[22371.]—Will some one that has had experience of the following, please advise me? Among other bee-keeping appliances at Cork Exhibition, I saw a feeder which I thought a good one. It is a round tin, about 4in. diam. and 2in. deep, with an inch hole and tube, standing 1½in. high in centre of tin. A thin piece of wood is cut to fit inside of tin, with a hole to allow tube to pass freely through. The syrup is poured in through a small lip, soldered to the outside of tin, the wood of course floating on syrup, the bees having access to same through centre tube and a number of small holes being burnt in the float, and a piece of glass laid on the top of the tin to prevent their escape.

Now, it seems to me a first-rate plan for feeding up for the winter: but am not so sure about its being adapted for stimulative feeding. Will it do to give only a very small quantity regularly in the tin, as I do not like the bottle plan of feeding? I most fully endorse every word of letter (22323) by "G. J. H." **J. Perry.**

[22372.]—I am very sorry that Mr. Abbott should have misunderstood my allusion to his leaflets. I am perfectly aware that the valuable information given in them is based on long and varied experience; they have taught me an immensity; no one can value them more than I do, and they ought to be read and closely studied by every bee-keeper. I mentioned them merely that I should not get answered by some one who, knowing nothing practically of the subject, but having got hold of some of "Abbott's Leaflets," would go quoting a lot out of them, which he most likely did not understand, and which I knew already and could read in the original, and thus an answer which was taken from a practical source would become theoretical as far as the person giving it was concerned. I have a horror of persons who seem to make it their business to answer questions on all sorts of subjects in this kind of way: though the leaflets are "exhaustive," they are so "in a general sense," and a beginner will often want a little *particular* information which may often very usefully come from one who was not himself a beginner not a very long time ago as Mr. Abbott. I have now to thank "J. I. S." for the information which he has given me as to "Examination of stocks," "Stimulative feeding," and "Transferring stocks," which is just what I wanted, and which I have got in time to be of use. As to the first two, this is the first spring that I have had bees in bar-frame hives. I therefore have no *practical knowledge* of how to manage them, and I know no one who has. We transferred stocks most successfully in July and September last, but did not know how early it could be done with advantage, which, thanks to "J. I. S.," I know now. We have made some excellent hives, the same as "J. I. S's." for all practical purposes, taking the same frame. I [illegible] made one, the first, less than 20in., and am now making a batch 21in., which I expect will be in some respects more convenient than 20in., for working with section frames at back.

I think there must be some great mistake in the scantling of timber given in "J. I. S's." hive; is it not more like that for frames than for hives? My inner box is made of ¾ and outer of inch stuff, and I have it double all round and packed with cork dust. I also have movable and [illegible] double bottoms kept well home by a wedge.

As to position, I am in a very early place, perhaps, with the exception of a few very favoured spots in counties Cork and Kerry, as early as any in the South of Ireland. I should also say it is a good place for bees, particularly so early in the season. The furze is in blossom already, and the catkins of the hazel will be in a very short time covered with pollen; there are also a quantity of [illegible] trees which flower very early, and fruit trees and quantities of both sloe, thorns, and hawthorn which flower very profusely, and earlier than either lots of Darwinii, which is now just coming into bloom. Numbers of my bees are out every fine day, though I have the doors of the hives nearly closed and a piece of board laid up against them on the flight board so as not to let any light get into the hives.

We introduced a Ligurian queen on the 1st October, and in that stock the bees are mostly Ligurians now. The bees continued breeding and working very late last autumn, bringing in quantities of both honey and pollen from the ivy, of which there is an immense quantity, up to 1st November and even after. I hope "J. I. S." will keep me in mind, and further on, give me, and others, the benefit of his experience as occasion arises, or rather *before* it is likely to arise. Has he ever tried his hand at raising queens? I hope to try as soon as it can be done, though *how soon* I don't exactly know. I have got the Rev. G. Raynor's admirable pamphlet; but would be glad to get some particular advice from "J. I. S.," or some one else, if he has not tried it, and particularly how soon it would be well to commence, which I think I would do by exchanging the combs, without any bees, of the Ligurian stock with those of a black stock, taking away the black queen and leaving the black bees to raise young queens from the Ligurian eggs in the brood comb given to them in exchange for their own. This is the plan recommended by Mr. Raynor as the safest, there being no risk of losing the original imported queen.

G. J. H.

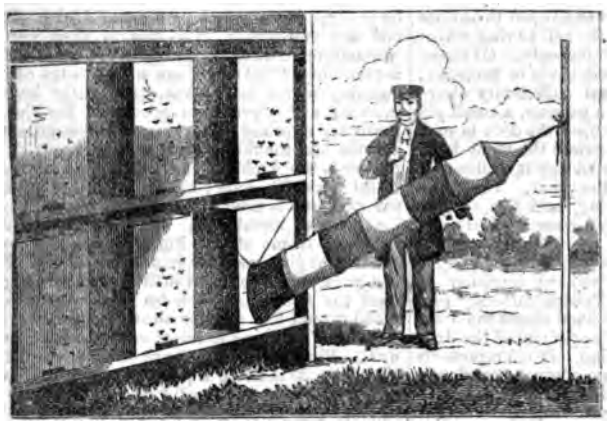
BEE FARMING IN NEW SOUTH WALES.

[22373.]—The operations in bee culture going on in Parramatta, as described in the *Town and Country Journal*, are well deserving of being ranked as bee farming, and may interest some of your readers who are reviving the interest in the subject formerly manifested in our columns, and, as will be seen, the operations are carried on after the most approved system of the German apiarians, which differs only in the form of hive used and a few minor details from the approved system followed in Britain and America. In December, 1881, a skilled bee master, Wilhelm Abram, arrived in Sydney from Germany, where bee culture is a recognised industry. He brought with him certificates of qualifications from no less authority than that of the celebrated Dathe. On his arrival in Sydney Mr. Abram placed himself in communication with Mr. S. MacDonnell of that city, an enthusiastic amateur bee keeper. Mr. MacDonnell saw the opportunity which the advent of Mr. Abram gave to establish a bee farm on a commercial scale and conducted by a skilled apiarian, and conceived the novel idea of working it as a joint stock venture. Four well-known gentlemen in Sydney joined him and Mr. Abram in the venture. As it was intended that the operations of the company should eventually be [illegible] Italian bees, a race superior in many important respects to the ordinary black bee, the concern was named the Italian Bee Company.

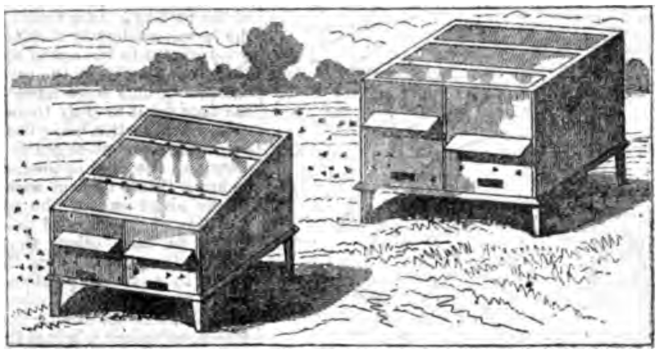
Mr. Abram, before leaving Germany, had purchased some of the prize swarms at an exhibition of Italian bees in Germany, and the Italian Bee Company commenced operations with these on a rented piece of ground at Parramatta in January, 1882. An importation of prize queens from

America was made, and the operation of queen rearing was entered on. In the mean time a number of colonies of the common black or English bee afterwards had been secured and transferred to frame hives, and as Italian queens were reared the black queens were removed and replaced by Italians, the progeny of which replaced the black bees as the latter died out. Much attention was not paid to producing honey until the race of Italian bees should have been firmly established, and the result was that in the spring of last year there were about 80 colonies of gold-banded Italians actively at work. The company before this secured the fee simple of a piece of ground in Kissing Point-street, Parramatta, where operations are now conducted. There, a few weeks since, on visiting the establishment, we saw the hives opened, the frames containing beautiful sheets of comb removed (the gentle Italian bee showing no signs of anger during the operation): the comb was then placed in a centrifugal machine, which threw the honey out by centrifugal force, leaving the comb undamaged and ready to be returned to the hives for the bees to fill over and over again with nectar.

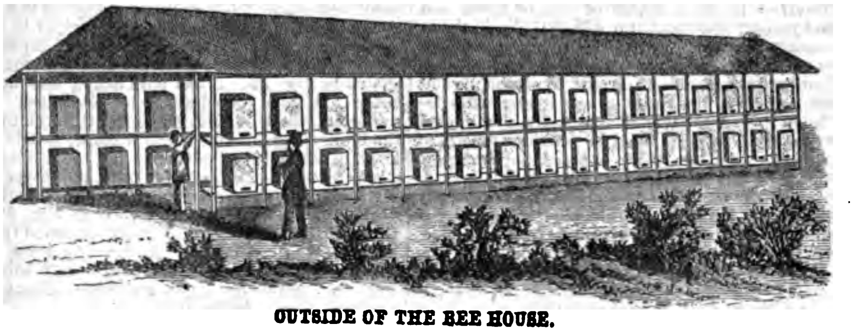
The bee master is an adept at his profession. Pipe in mouth, he opens hive after hive, blowing a whiff of smoke upon them, to give the bees something else to think about when they seem any way refractory, a projection from the stem of the pipe allowing this to be done conveniently. The hives used are of the German bar-frame kind. They open from the back, and each hive is two stories high, so that ample space can be given to the bees when they are storing honey rapidly. The main house is 150ft. in length, 10ft. high, 10ft. wide, and two tiers are arranged on each side as in sketch.



SWARMING BAG, A GREAT IMPROVEMENT.



QUEEN BREEDING HIVES.



OUTSIDE OF THE BEE HOUSE.

THE QUEEN CAGE

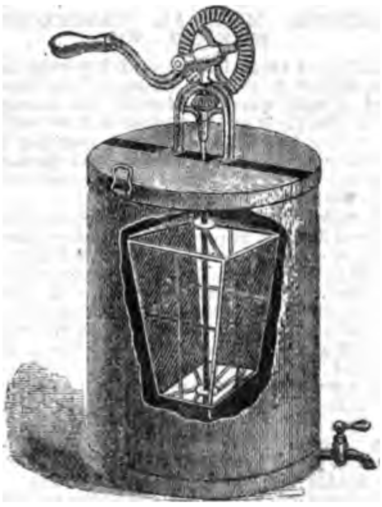
The swarming bag is one of the best things we have seen in bee culture. It is about 6ft. in length and 1ft. in diameter, and formed of alternate lengths of calico and mosquito netting, each length having a ring of cane inside, to hold out the bag as shown in the sketch. When the bees are about to swarm, the bag is fastened on to the front of the hive and the other end fastened to a stake. When the queen emerges she bounds up into the upper end of the bag, and is quickly surrounded by her followers. Thus the swarm is captured with ease, the alternate breadths of mosquito netting and calico making the interior light and enticing for the bees to enter and cluster. They are then shaken into a bar-frame hive.

The queen breeding hives are much smaller than the others, and are arranged at distances of about 20ft. apart alongside the fences. Two or three frames of brood comb are put into each hive, with a queen cell coming to maturity. When the queen bee hatches out of the cell, she makes a flight (the only flight of her life) in order to meet a drone or male bee. She is then fertilised, and becomes the mother and queen of a family, laying eggs at the rate of 2,000 daily when the season is good and stores abundant.

The centrifugal machine is used for extracting honey without destroying the comb. The caps with which the bees seal up each cell of honey are sliced off with a very thin bladed knife of simple form, and the frames are set in the metal baskets of the inside of the machine. Then, by turning the handle, the honey is thrown out and runs down the sides of the machine, from which it is drawn by a tap. In this way absolutely pure honey is got without any other substance whatever, and without injuring the bees or annoying them. The queen cage is drawn to scale, as is the queen or mother bee seen inside. In America and other places, these queen cages and mother bees are sent by post, and thus hives are strengthened and the breed of bees improved. One of the objects of the bee farm at Parramatta is to send out queens and improve the race of bees, as well as the hives and the quality of the honey. There is abundant room for improvements of the kind. From this country the very finest honey ought to be exported in quantity, although at present very poor stuff is sent us from places where glucose mixtures are worked up for honey. The bees at Parramatta are doing excellently well this season, as are also Italians recently received from Queensland. **F. N. T.**

PASSAGE OF ELECTRICITY.

[22374.]—One evening, about a year ago, I put a plate of zinc and copper in a glass cell in the usual sulphuric acid solution, and, connecting them by a wire, examined the intervening liquid with a large reading glass, previously placing a strong light on the other side of the cell. I did not, of course, expect to see the molecules of water moving; but I thought that I might possibly perceive the indications of a current by the movement of floating particles in the solution; and, in order to make this more conspicuous, I dropped small pieces of thread, &c., attached to little bits of sugar, between the plates, and watched their rise on the sugar dissolving. As far as I could judge, the threads came up perfectly straight as regarded their course, showing no tendency whatever to be drawn towards either copper or zinc. The tiny particles in the fluid also sank and rose as perpendicularly as though nothing were going on; and, whether the current was passing or not appeared to make no difference to them. Having placed a galvanometer in circuit, I could test this. The usual bubbles appeared on the copper, and the zinc was slowly dissolving: but nothing else was apparent. While watching the exhibition of the electrical microscope at the Crystal Palace a few days ago, it occurred to me that, if a similar experiment to mine were thrown on the screen, something *might* become visible under such enormous magnifying power; and at the close of the lecture I suggested it, but the lecturer did not seem to think it possible. I should have thought it feasible: and, therefore, send this letter to see what others of "ours" think of it.



CENTRIFUGAL MACHINE, SHOWING INSIDE.

I suppose such an idea has been thought of; but no work that I have makes any mention of it; nor, I presume, has there been any microscopic power previously available equal to the one referred to above? I never remember seeing the experiment tried in the Polytechnic times, though I often saw their microscope; perhaps it was privately tried and nothing resulted, so it was thought useless for a public exhibition. **B. Harcourt.**

STORAGE BATTERIES AND ELECTRIC CURRENTS.

[22375.]—An expression of opinion as to the various accumulators now in the market, from those who *have used them*, would be of much assistance to those who, like myself, are only waiting for the improvement of these inventions to adopt them.

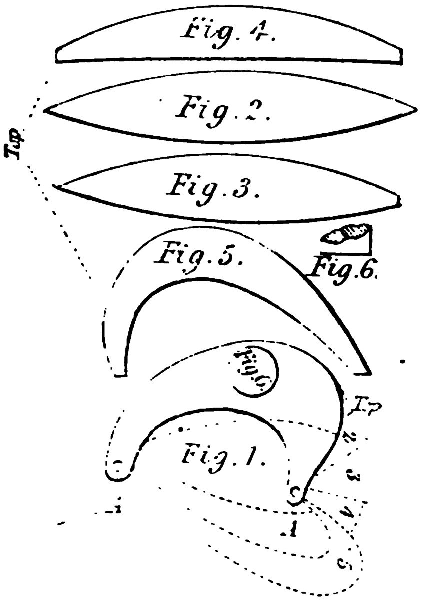
Besides the original Planté, there are the Faure-Sellon-Volckmar, the Elwell-Parker, and the Brush "B. T. K." system, the Barnett, used at the Paddington Station; and probably others. For my own part, I should be greatly obliged to anyone who will describe the advantages, and the faults, of each of them.

As to "current," I have found in the last volume of the *Electrician* a definition by Mr. Sprague, which seems to give one holding ground, at last; he terms it "the rate of flow." Well, that is intelligible; water in a ditch, and water in a river, may each be flowing at three miles an hour, though the volume of one will be very different to that of the other. Then the next thing will be to learn what, in "current," is the analogy to volume of water. Is it to be "density," or "high and low tension"? Or shall it be called E.M.F.? which I now begin to believe means neither more nor less than "difference of potential."

By the way, there is also a letter in the *Electrician* from Mr. Varley, protesting, as I ventured to do, against the multiplication of units and terms in electrical science. **Antares.**

HOW TO MAKE A SELF-SUPPORTING EAR TRUMPET.

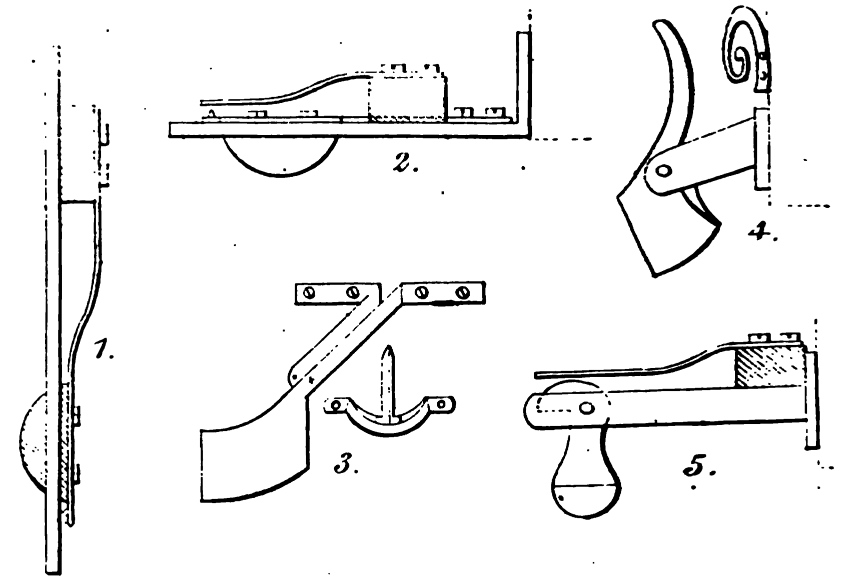
[22376.]—SEEING a letter a short time ago in your paper relating to a simple ear trumpet, I now venture to give below instructions for making a simple, yet effective one. I contrived this instrument so as to fit on the ear and support itself, thereby leaving the hands at liberty. I will now describe it as briefly as possible. Procure a piece of tin about 8in. square, cut out five pieces, as shown in the following cuts: then punch the two holes, A A; get a piece of square elastic (such as is used by boys to make that destructive little instrument—the catapult); stretch it from A to A, and secure each end. I use elastic so as to fix it on with more ease and comfort than would be the case if string or cord were used. Now, round off the inner edge with solder, or wire it, so as not to cut the ear; bend Fig. 2 to fit the outer edge of Fig. 1, and solder it, then fix and solder Fig. 3; then proceed in the same manner with Figs. 4 and 5. The edge of Fig. 5 should be rounded, as in the case of Fig. 1. The rough edges where joined are then filed, and the crevices filled with solder. Cut a piece from a cork (as in Fig. 6), and glue it on to Fig. 1. This rests against the temporal bone, and steadies the trumpet, which may now be considered complete; but japanning outside and a coat of flesh-coloured paint inside greatly improve its appearance.



M. Y. C.

DOOR CONTACTS.

[22377.]—JUDGING from recent queries and correspondence that some of our readers are interested in the subject, perhaps I may be allowed to offer them rough sketches of five typical forms, varieties of which are now almost as numerous as makers themselves. No. 1 represents the class in which contact is maintained, whilst the spring is at rest in the position shown, but is broken by pressure on the stud. This is the form ordinarily used for thief alarms; it is mortised into the joint of a door between the hinges, or between the beads of a window sash, so that when the door is opened or the sash is raised, the bell continues to ring until they are closed again, or the circuit is broken at the controlling switch. No. 2 is an ordinary form which is fixed upon the door frame in such a way that the door, in passing strikes against the stud, and, pressing it up, makes contact between the two springs. The bell, in this case, rings when the door is either opened or shut; but as there are, unfortunately, more people who open a door than who close it after them, it often happens that the door gets pushed nearly to, without being actually shut, and coming thus to rest just under the contact, the bell keeps on ringing until someone stops it by opening or shutting the door entirely. As the too frequent repetition of this kind of thing was good neither for the tempers of the inmates nor the endurance of the battery, other forms were devised to obviate the inconvenience by causing the bell to ring whilst the door was in the act of opening only. Of these, No. 3 was probably the earliest made in England; the two springs were fixed just sufficiently above the door for it to clear them in passing, a small pin of thin oval section being fixed upon the door in such a position as to press gently against the right-hand spring as the door opened, deflecting it sufficiently to bring it into contact with the other. The curve of the broad end of the spring, and the oblique direction of the edges of the pin were so nicely adjusted to each other, that when the door was closing, the pin passed on the left-hand side of the curve as near as possible without touching it. No. 4 is a now well-known French pattern "*pied de biche*; like the others, it is fixed above the door, which, on opening, brings the upper end of the drop into contact with a spring behind. No. 5 represents another class of single-action contacts originally designed, and made by a contributor to the "E. M.," though long since copied by our ingenious neighbours across the Channel—its mode of action will be obvious. Another type of door contacts I have not referred to, as a sketch of one of them was given by a correspondent at p. 478 (52739): in these, one contact spring is fixed upon the door, and the other on the frame in such a way that they touch each other in passing—they are, of course, double action, as in No. 2. Those of our readers who desire these things to work satisfactorily should bear in mind that they are fixed in positions where, of all others, they are most exposed to draughts, bringing in any quantity of dust and damp; all points of contact should, therefore, be carefully platinised, whilst some kind of protecting cover is also desirable. The ingenious amateur will soon, however, discover for himself that in practice there are many other little points which need attention in the fixing of even such simple things as these, in order to insure that they shall continuously work without a chance of hitch at just the very times when most relied upon.



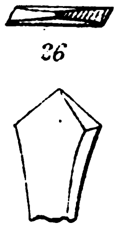
R. T. Lewis.

AMATEUR MUSICAL INSTRUMENT MAKING.—VI.

[22378.]—I NOTED five sizes of key cups in the table, in part 4, as being necessary; but of course seven or eight sizes would make the instrument look neater, for it will be noticed that the cup outside is about 5 mill. larger than the sounding hole, if the key is between No. 1 and 6, and the smaller keys have the cups about 4mill. larger than the holes they cover.

To make cups, take, say, five pieces of round steel and fit them to run as lathe centres; turn up to proper diameter, and round the ends like the cup Fig. 19 (each being nearly 1 mill. less than the outside sizes). An iron plate about ¼in. thick is drilled with about a dozen holes, the largest being 19 mill. and the smallest 8mill. They can be then reamed out with a taper widener 8in. long, 19mill. at one end, and 8mill at the point; thus each hole can be made a certain amount larger than its neighbour, and by turning the plate two sizes are obtained; the edges on each side are then carefully smoothed with a countersink drill. The metal being softened, is cut into squares, and the corners cut off, double the size of the required key. It is then placed on a plate, over a hole about 1 mill. too large, and the steel punch above it, which is then gently struck with a hammer till the outline is depressed about 1mill. The hole next smaller is then oiled and the metal driven further by the punch; the edges of the key are then trimmed close by shears and the punching proceeded with, till [illegible] and size are correct. The key is then put on a wooden pin, turned up and polished in the lathe; it is then cut off to length, say with an edge of [illegible] outside, which is afterwards slightly burnished inwards, and serves as a good hold for the pad. Drills are required of various sizes for pillars, &c. and the best for this work are Fig. 25 and 35. The former is the Archimedean, and should have a [illegible] metal spiral 7in. long; the latter is for holding in the vice, and is used by jewellers. Drill Fig. [illegible] is for general metalwork, and may be made of umbrella frame steel. Fig. 27 is a wood countersink about ⅜in., used for smoothing holes. Fig. [illegible] is a generally useful flat drill for wood. Fig. [illegible] is used for boring pillar holes and flattening the wood round the edge to allow the pillar to screw close up. All these are used with the Archimedean drill. Figs. 30, 31, 32, 33 are used with drill Fig. 35. Fig. 30 is sharp along the edges only, and is used for boring out small tubes or widening holes. 31 is used to roughly face up the edges of pillar heads; 32 is for facing up angle pillars, and consists of a small rose cutter, jammed on a round shank, removable when required. Fig. 33 is used to widen the end of a tube when it is desired to solder another tube to it, the other tube being tapered to enter it a little way, the soldering arrangement being shown in Fig. 36. B is a wire fitting the bore of tubes C D, to be joined at A by blowpipe. After soldering, the drill (Fig. 30) is run through to clear the bore. Fig. 37 shows how a shank is held on a key cup while being soldered; the tongs consist of a pair of engineers' inside calipers held together at F by a metal strap shown at G. The method of drilling the soundholes is shown at Fig. 38. H being the body, lying on a block of wood G, and held down by a wood bar K, by two screw nails, the drills used being sharp centre-bits shown at Fig. 34, driven by a joiner's brace; about seven sizes are required altogether.

Springs may be made from sewing needles and flat springs from old watch spring. The former are broken near the thickest part retaining the point end, are then put on a thick metal tray over a lamp, and cautiously heated till they are of an even blue colour, taking plenty of time and rolling them about to insure regularity. The thick ends are then slightly flattened with a hammer and the spring slightly curved like Fig. 39. Flat springs should not be made of too thin material, as breadth does not make up for thickness; the watch spring should be slightly heated to reduce temper where the hole is bored for screw, the end nicely filed and bent to lessen friction (see Fig. 40). Flat springs are best for keys that require to be kept shut, especially if they are large; needle springs do nicely for rings or keys that are small or remain open. The tone of every wind instrument depends on the tightness of the pads or keys, and the execution of a player is greatly improved by the nice working of key-springs; generally the smaller travel a spring has, the longer it lasts, and the more comfortable it feels to the player. A spring requires its least power after a key is raised, and its greatest power to keep a key shut. This cannot always be obtained, but the nearer it is approached, the more perfect will the instrument be mechanically. This is effected by having the spring exactly the proper length, that, when the key is opened, it slides below the centre or joint; when the key is shut, it recedes from the centre, and thus obtains leverage—consequently strength (see Fig. 41). It will thus be apparent that time spent in adjusting springs is not lost when the principle is understood. Screw plates are required for making taps, to screw pillar heads, &c.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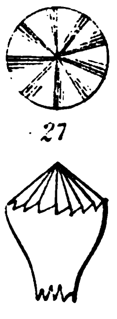
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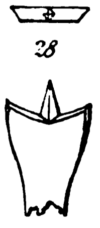
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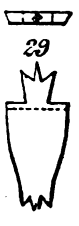
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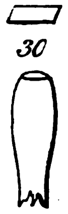
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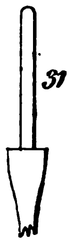
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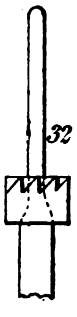
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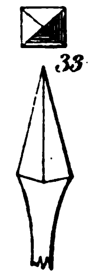
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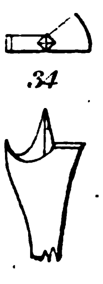
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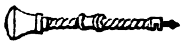
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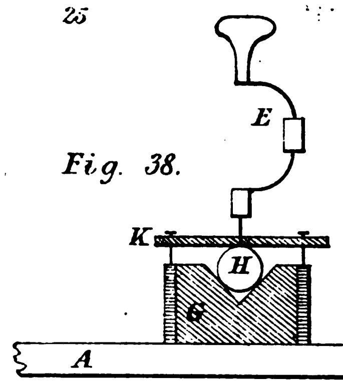

Fig. 38.

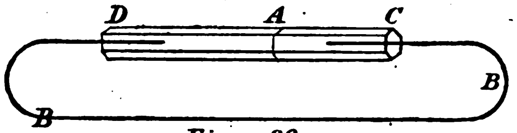

Fig. 36.

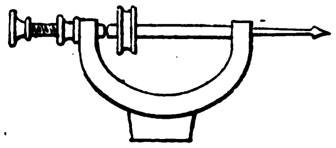
Fig. 35.

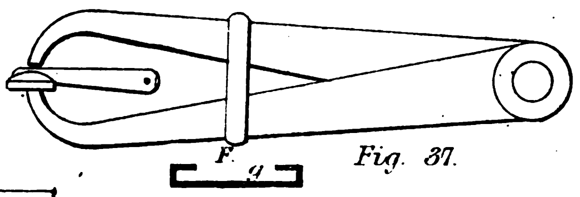

Fig. 37.

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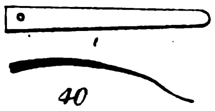
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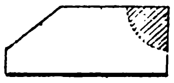
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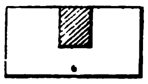
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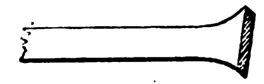
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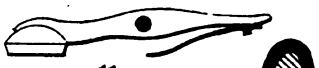
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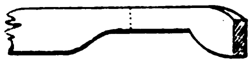
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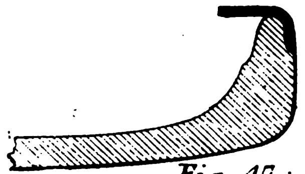
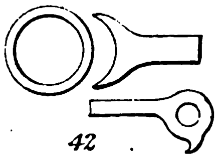


Fig. 47.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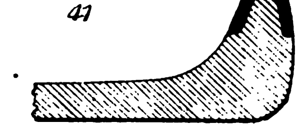
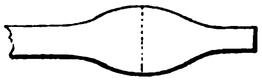


Fig 48.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and for this purpose, perhaps, two will be required to fit all the screws from Figs. 12 to 16. As to the screw-foot of pillars, Fig. 21 and 22, they are usually put on by the maker, but are generally defective; therefore, a plate or screw-dies to fit them is a convenience. A tap for screwing the holes in the body may be made by soldering a pillar to a rod and filing the screw into a square. Taper screws can be made on pillars by using die-pincers, having the pillar held in a chuck, and running the lathe the reverse way. Rings may be made two ways: first, wire can be made into the rings and soldered, turned up, and then soldered to the shank; this, however, is easy only after practice. It will be found best to bore and cut the rings out of solid metal, No. 11 or 12 B.W.G. = ·12in., then turn up in the lathe and solder to the shank (see Fig. 42.) Shanks are made from wire, 5 B.W.G. = ·22in.; it is flattened a bit (see Fig. 44), and then hammered into a slot in steel block, 43, which alters it to shape 45, 46, and is then cut off at the dotted line; eventually, being shaped by a file into Fig. 42, then soldered to the ring. Before treating of each key in detail, we now return to the body and complete the bell, &c., left off at end of Part 2. It must be noted that the body enters into the top end of bell, which is formed into a socket, bound by a metal ring, and in order to assimilate the narrow bore with the taper of the bell, the body must be widened at foot, up to two cent., above the middle of key No. 1 (see Fig. 6); this meets or continues the general curve of inside of bell. The bell measures, on the C clarinet, 9·6cent. long, including both rings; at the upper ring the diameter outside is 3·1 cent. At lower ring the wood is 6·8 cent. For B flat the length is 10·5cent. The wood outside at upper ring is 3·5cent., and at lower ring the wood is 7·3cent. The inside of both bells have the same taper, and may be cut by the same tool, which reaches, as before stated, up to the first hole. In the C clarinet, the tool will go up 12cent. and in the B flat it will go 13·5cent. This cone measures in length 13·5cent.; width at top, 14·5mill; width at bottom of socket (4·5cent. from top), 22mill. At 7cent. down it is 28mill.; at 9cent. down it is 34mill.; at 12cent down (bottom of C bell) it is 41mill.; and at 13·5cent. down it is 54mill. If, then, 4mill. of wood are allowed at each side, then these sizes plus 8mill. will be the outside sizes, except at the socket and lowest ring as mentioned above. To make the bell: a piece of wood, proper size, is chosen, leaving plenty of room, and bored through with a ¼in. drill; it is then roughly turned up, and inserted in a large wooden cup-chuck; the inside is then cut out with a turning gouge, near the size, it being finally finished with a steel scallop or cutter the size of the cone; this may be made by turning a piece of wood to the size, and being cut through with a saw, a steel cutter is inserted and secured by pins, after being dressed to the outline of curve. The wood bell is then removed from chuck and placed on another fitting the internal space; the outside is then turned, finished, and varnished. The socket cut out and both rings fitted. The large ring may be made like an ordinary ring, and secured by pinning; but the following is better and stronger. Take a strip of German silver, 11mill. broad and 22 B.W.G. thick, solder the ends and form into a ring about the correct size; a very narrow groove, the size of this ring, is then cut by the lathe, in hard wood about 8cent. deep. The ring is inserted, and the 3mill. beaten inwards, forming an angle section; the outside and end of this ring are then turned up and the metal softened; it is then put on the bell and the flange beaten into its place, the ring is then finished up and polished. Fig. 47 shows the ring fitted on bell before closing. Fig. 48 shows section of the work complete.

9th Feby., 1884. **Vulcanite.**

LATHE WITH FRONT SLIDE.

[22379.]—I believe Mr. Carre's plan—to make the top V on the inner side—is, on the whole, better than placing it as figured in my diagram, as it will tend to keep up the truth of contact between saddle and bedpiece. There should be a hollow or space below the path of the fast V of the saddle, so that chips or turnings might fall in this, and be easily swept away without interfering with the contact faces of the slides. I am glad our valued instructor, "J. H.", intends to devote a little attention to this form. With this and the pattern for a suitable gap piece, he will render his admirable papers on the lathe complete. **Orderic Vital.**

OVERHEAD LATHE.

[22380.]—Will the author of "How to Make a Cheap Lathe" kindly add to his invaluable article a description of patterns for overhead motion, suitable to strong 5in. treadle lathe, for driving drills and cutters for metal? **Sailor.**

UNLIMITED LIABILITY LATHE.

[22381.]—It was with great curiosity that I read the article on p. 507, by "O. J. L.," upon the "Unlimited Liability Lathe."

In the paper "O. J. L." professes to show how any ordinary lathe can be converted into one in which articles can be turned in size out of all proportion to the maximum size for which the lathe was originally designed to accommodate.

Now, does he do so? I think not; nor does he say that *he has turned anything by means of the converted lathe.*

I think we ought to have a little more data to work upon before altering a lathe in the manner suggested, because although it may look well upon paper to the originator of the idea, it may not work so well practically.

It is quite against my experience to find it possible to turn (even the circumference only) a superfices with a diameter of 2ft. upon a 3in. lathe, I question whether there would be power enough in the treadle, band, &c., to even make the work revolve, and we must not forget that great power is required as well, for shearing or cutting the material.

Ordinary turning requires the assistance of a rest to support the tool, as the work would when rotated (if the tool be not supported) cause the tool to descend in a tangential direction, and ultimately leave the work, without producing any result as far as turning is concerned. The work when being turned by the usual method, is fixed vertically, and at the point of contact of the tool and the periphery of the circle; tangents drawn from that point would be perpendicular, or nearly so, and the rest being placed under the tool, and horizontally, it overcomes the natural gravitation of the tool, and the tendency of the circle to drive down the tool tangentially and away from its correct position. Ergo, "a rest" is an absolute necessity to support the tool when turning.

Does "O. J. L." comply with that imperative condition in his proposal for unlimited liability? It will be seen that he does not.

By his plan the work rotates in a horizontal plane, and all tangents to the circles will be hori-

[illegible]ontal, and the rest will [illegible] in a lower parallel plane, and not at right angles to the work [illegible] fore, when operations are [illegible] the tool be fixed, and it is not proposed to be [illegible] in the article), the tool will [illegible] in a tangential direction, and along the face of the rest; the result would be about the same as trying to turn without a rest. Of course, some of the evil effects might be overcome by a projection upon the top of the rest (provided always that the work can be got to revolve). "O. J. L." does not propose any addition to the rest for that purpose.

I should like to have a little more said about turning the face of the circle by the suggested plan. "O. J. L." seems to be (discreetly) silent about that, to me, very difficult part of the work. Has he turned a 2ft. circle on a 5in. lathe.

In the sketch the disc of the chuck is shown fixed upon the boss eccentrically to the axis of the boss. Why is that? Also, in the drawing, the band is shown passing down from the guide pulley under the rest, and thence to the back of the wheel, and there is not shown any portion of the band round the front of the wheel.

Perhaps "O. J. L." will explain this, as I cannot understand the action of the band under these conditions.

W. A. Barber.

THE FRONT SLIDE LATHE AND MILLING.

[22382.]—I AM a good deal smitten with the design suggested by F. Carre, in your issue of last week. When he says, "the bracket for rest could be made to slide vertically," he proposes a pet idea of mine, which I have been too busy to work out, and which I think might prove a valuable one. I propose to have a strong vertical slide in front, where he has written "bracket": the slide should carry the cross slide of the rest, which would be drawn firmly down by the raising and lowering screw, into a kind of shoe, when doing plain turning, so as to give solidity. The slider-plate of this cross slide having in it the circular groove for the T-headed bolts securing the upper part of slide-rest, should be made as large as possible, so as to form a table to which to bolt work to be bored, which could then be most easily adjusted level with the centres by raising the vertical slide. This table would also receive milling centres or work to be milled, the cutters being placed on the mandrel nose.

There may be objections to the plan which I do not at present see; but we shall all be wanting to do milling soon, and this plan appears to me far better than a detachable vertical slide rest. I commend the idea to Mr. Bear, and hope F. Carre will persevere with it.

Tunbridge Wells. **F. A. M**

MOLLER'S PROBE-PLATTE.

[illegible] HAVING lately received from Mr. Baker some beautiful samples of Moller's latest work—viz., Probe-platte mounted in phosphorus, monobromide of naphthaline, balsam and dry, a few remarks may possibly interest some of your readers.

With regard to strength of resolution, I think the [illegible] carries the palm; it is closely run, however, by the phosphorus; next comes the monobromide, [illegible] balsam. The phosphorus, like all dry [illegible], has an unkempt appearance, but [illegible] has the special charm of combining [illegible] strength of resolution with the well known [illegible] balsam. When speaking, in the following [illegible] as a fine test, I mean merely as [illegible] test, with oblique light.

[illegible] I should choose, for really testing [illegible] with axial illumination, would be [illegible] Triceratium favus (in- [illegible] No. 1; Navicula lyra (one of the [illegible] I have ever seen), No. 3. P. litto- [illegible] formosum, No. 60.

[illegible] further I ought to mention [illegible] compare some of the diatoms [illegible] with the same kind in [illegible] with hardly any exception, all [illegible] in phosphorus, as also in [illegible] only some are.

[illegible] having seen a selected dry [illegible] worth looking at. I do not [illegible] should be so; it is, however, [illegible] who have had a large, if not [illegible] myself, have stated the [illegible]

[illegible] of obtaining a dry A. [illegible] tipping until you get [illegible] valves are exceedingly [illegible] a laborious process to [illegible] between a 60 [illegible] early 100 balsam [illegible]

[illegible]

[illegible] long. striæ, good [illegible] very similar to N [illegible] ·0041, striæ 63·5 [illegible]

No. 8, P.P.—Nav. Rhomboides, length ·0059, same as T.P. [illegible]: length ·0075, striæ 60 in ·001, resolved by [illegible] N.A. ·64 = 80° and [illegible] N.A. ·64 = 79°.

No. [illegible], P.P.—Nav. Rhomboides, length ·0043, similar to the English Rhomboides on slides commonly labelled Amici's best striæ (estimated) 75 in ·001.

No. 11, P.P.—Nav. Crassinervis, length ·00287, cannot resolve it with any dry lens, striæ finer than in N. crass.: T.P. 3-4-30, length ·00359, striæ [illegible] in ·001, which wide-angled dry lenses resolve.

No. 15, P.P.—Gram. oceanica, small, but coarser than usual, length ·00192, ¼ N.A. ·77 = 100° resolves it. The same on T.P. 2-1-15 is longer—[illegible] ·04, striæ very much finer: 88 in ·001, important diatom as limit of resolution with dry lenses.

No. 28, P.P.—Nitz. sigmoidea, fine test for ¼ of ·80 N.A. ·4[illegible].

No. 31, P.P.—Nitz. curvula, well-known test, length ·0046, evidently identical with Nitz. sigmatella: T.P. 2-5-10: length ·0042, striæ 89·6, both beyond the resolving power of dry lenses.

No. 32, P.P.—Nitz. obtusa, length ·003, the limit for dry lenses on the P.P., resolution just beginning with ¼ N.A. ·88, dry 1/6 N.A. 1·0 masters it. Very different from Nitz. obtusa, T.P. 2-5-12, length ·00[illegible], striæ 99·5 in ·001, resolved by ¼ N.A. ·77 = 100°.

No. 33, P.P.—A. pellucida, long and coarse, ·0046 beyond the power of dry lens, striæ (estimated) 92 in ·001.

No. 34, P.P.—A. pellucida, small and very fine; ·00283, slightly smaller than A. pell. T.P. 2-6-6; length ·00329, striæ 100 in ·001.

No. 35, P.P.—A. Lindheimeri, fine test for dry lenses of moderate apertures: striæ (estimated) 70 in ·001.

A dry ¼ N.A. ·81 = 108° will resolve all except Nav. crass., Nitz. curvula, the two Amphipleuras, leaving the Nitz. obtusa doubtful.

Edward M. Nelson.

MICROSCOPICAL—AN OFFER.

[22384.]—I SHOULD be glade to forward a few Podura (Lepidocyrtus curvicollis) to any one wishing to study their beautiful scales.

Joseph Wall.

Woburn House, Woburn Hill, Green-lane,
Liverpool.

A NEW MOTOR.

[22385.]—As a great number of readers of the MECHANIC are interested in the tricycle, and any suitable motor which could easily be made applicable to the same would be looked upon as a great advance upon the present mode of propulsion, I copy the following remarks from the *Tricyclist*, Dec. 25th, 1883, to which I would refer our readers to a more lengthy description than can be given in this letter. A company is formed to work the invention of a Mr. Sturge. The following are the inventor's statements as to its capabilities.

"This invention is calculated to entirely revolutionise most descriptions of light traffic, and be a means of opening up an entirely new as well as great and important industry, equal in many respects to steam and electricity."

That is clear enough, in all conscience.

The pamphlet continues—

"Of the various means of locomotion hitherto employed, none can compare with Mr. Sturge's system for speed, simplicity, and economy, and although the invention is not at present applicable to heavy vehicles such as railway carriages, tram cars, &c., the field for its use is still sufficiently wide to render it one of the most important improvements of the age.

"The striking advantages of Mr. Sturge's invention which give to it absolute and undisputed superiority over any other existing invention or contrivance, may be briefly summarised as follows:—

"1. Propelling power is provided, and no personal exertion is required beyond guiding the carriage.

"2. Any rate of speed up to 15 miles an hour is attainable.

"3. The length of the journey is immaterial.

"4. The carriage will travel up hill as easily, and almost as quickly, as on a level road.

"5. The power applied is specially adapted for rough or heavy roads.

"6. The apparatus is most easily regulated and controlled, and the carriage can be guided with equal facility and stopped instantaneously.

"7. The propelling power is contained in a very small compass, and is of no appreciable weight.

"8. The cost of construction is exceedingly moderate, from £2 to £3 being sufficient to adapt the apparatus."

The Editor concludes thus:—

"For should this motor fulfil the claims made for it, the question of aerial flight will be very soon solved, and the roadster tricycle will die out before Mr. Blank's aeroplane vehicle, with a record of 50 miles per hour, driven by a motor of no appreciable weight."

I should like to hear something more of this important invention: or are we to class it with the electric engine or Keely motor?

Geo. S[illegible]

8, Hawthorns-street South, Sunderland.

GLASS DISCS FOR REFLECTORS.

[22386.]—MR. CAPLATZI (22348) thinks my plan of getting glass discs for specula rather [illegible] and tedious. I grant it looks like this at first sight, but it serves my purpose better than any other I have tried, and I have tried many. To give Mr. Caplatzi an idea of what he ought to aim at in improved methods of procedure, I will explain how I go about getting, say, for example, a 6in. disc. I go to a glass-seller's shop in the town, where there are many such, I have no doubt, in London and other large towns. I order a piece of glass [illegible] and 1in. thick. This the tradesman [illegible] some of the plate-glass makers, and gets for me at 1s. 6d. The edge is nipped round—rough, of course, but still round as a whole, and perpendicular as a whole on its sides. This disc I take to the glass-cutter, with a circle of tin cut accurately round 6in. dia., and my curve gauge, both [illegible] scribed; he then rounds the edge smooth to the 6⅛in. dia.; the rough side of the disc he [illegible] curve, and chamfers off the angle all round top and bottom, so that the curved [illegible] face is exactly 6in. dia., and as round as the piece of tin. All this he has always charged me 1s. for: thus I get a 6in. disc ready for grinding for 2s. 6d. The dishing out the curve by the glass-cutter saves a lot of hard work, as it only takes me about one hour's work with rough emery to bring the surface to the curve of the tool, and ready to begin with my finer emeries. This will give Mr. Caplatzi an idea of what price he ought to be able to get the work done for, and at what price he ought to be able to sell the discs, edged and dished out, to the amateur, made from his stock of glass, and with the improved methods he will adopt, since a [illegible] others I get in proportion only cost me [illegible] And if he can find out some better mode by which he can sell them at a cheaper rate, I hope he will let us know how he does it, in the same way as we all are willing to help him. Many amateurs, I am sure, will be glad of the information [illegible] beginning with a 6in. or 9in. disc; above that size [illegible] discs have to be used. **H. A. Wassell.**

Addenbrook-villa, Love-lane, Stourbridge.

[22387.]—THE method described by Mr. [illegible] on p. 520 is that which I have reason to [illegible] would be adopted by glasscutters. The simplest form of putting it into practice would be to take a strip of sheet copper and bend it into a circle, brazing the ends or securing them by a double rivet of this shape —. That is now to be pressed on a block of soft wood, which is either provided with a handle or with a spindle and pulley, by which it could be driven from an ordinary grinder's wheel. I do not know whether emery and water, or emery and oil would do the fastest work: but the emery and oil would leave the cleanest edge. The only difficulty is starting. Firm pressure without a slip must be kept up until the copper has worked a little trench, then the speed can be increased. **Nun. Dor.**

PEN AND INK DRAWINGS FOR THE LANTERN.

[22388.]—THERE is much truth in the saying that "there is nothing new under the sun," as, although the following process is perfectly original as far as I am concerned, it doubtless will have occurred to many others: but, on the other hand, I believe that there are many of your readers who would be benefited by the publication of this method of preparing magic-lantern transparencies:—

1. Procure some cardboard of medium thickness, and cut this up into slips of the required size, to act as carriers. Next, in each of these pieces make an aperture of the required size and shape for the "picture."

2. Procure some of the thinnest paper possible, which will stand ink (i.e., without running). This paper should be of even texture, and free from watermarkings and other lines. Ordinary tissue paper will do for pencil drawings, but these do not look so well as those executed in ink, and ink will run if used on ordinary unglazed tissue paper. Having obtained the required paper, it is convenient to cut it up into pieces of the required size—i.e., somewhat larger than the apertures in the cardboard.

3. In addition to the above, the only desiderata are:—(i.) Ink (I use ordinary black writing ink but any other medium of sufficient opacity will do). (ii.) A fine etching or mapping pen. (iii.) Glue. (iv.) Gum. (v.) Canada balsam dissolved in benzol. (vi.) A camel-hair brush or two.

Having made a drawing, or taken a tracing, on one of the slips of thin paper, gum it, in position, over the aperture in one of the pieces of cardboard (being careful to let no gum fall on the drawing itself). Unless care is used, some difficulty may ise in getting the paper evenly stretched over the aperture in the cardboard, but, after a few trials, this is easily accomplished. Having got the drawing evenly arranged, glue another of the cardboard carriers on to the one holding the "picture" (of course, the apertures in the two cards must exactly coincide), and set aside to dry, weighting it to prevent "warping." When dry, paint *both sides* of the thin paper over with Canada balsam dissolved in benzol; this "clears" the paper, making it almost as transparent as glass, except where the lines of the drawing are. The balsam dries in about 12 hours, and then the "slide" is ready for the lantern. If the object is alone cleared, and the rest of the paper left opaque, the pretty effect of a luminous object on a dark ground will be obtained, and some drawings of medusæ, infusoria, &c., which I have prepared in this way, look very well.

I have no doubt, although I have not tried it as yet, that this process will answer for coloured pictures, though I am afraid the balsam will have a tendency to make aniline colours run.

I do not claim that this process supersedes pictures on glass, but it is certainly an easier and very much cheaper process, and all who try it will, I am sure, be pleased with the result.

In conclusion, I may say that I have not tried these slides with the oxyhydrogen light lanterns, and it is just possible that ordinary writing ink may not be sufficiently opaque for so powerful an illumination, but I think Indian ink would answer perfectly. **Fred. Farrow.**

Ardwick, Manchester, Feb. 16.

THEORY OF THE EYEPIECE. — V. — SUMMARY OF FORMULÆ — ON FURTHER APPROXIMATIONS FOR THE DISTORTION, AND GENERAL REMARKS—PROPOSED EYEPIECE.

[22389.]—It will here be convenient, for the sake of reference, to collect together the principal formulæ which we have obtained. We have, then, for the dispersion—

$$\frac{\sec.^2\theta\,\delta\theta}{\tan.\alpha} = \frac{b}{f_1 f_2}\left(2d - f_1 - f_2 + \frac{df_1}{b}\right)\frac{\delta f_1}{f_1} \quad ..\ 1$$

for spherical aberration—

$$\text{sp. ab.} = \frac{f_2^2 A_1}{(f_2 + c - d)^2} + A_2 \quad \ldots\ldots\ldots\ldots\ 2$$

for distortion—

$$D = \tfrac{1}{2}\frac{v^2 h^2}{f_1^3 f_2^3}(f_1 + f_2 - d)^2(f_1 + f_2) \quad \ldots\ldots\ 3$$

The two first of these are general, and apply to any ray whatever and any pair of lenses, b and c being the distances from the first lens, and the point where the ray meets the axis before and after refraction respectively. Where the ray, after second refraction, passes through the focus of the eye lens nearly, $b = \frac{f_1(d - f_2)}{f_1 + f_2 - d}$, by means of which eqn. (1) becomes—

$$\frac{\sec.^2\theta\,\delta\theta}{\tan.\alpha} = \frac{(d - f_2)^2 + f_1 f_2}{f_2(f_1 + f_2 - d)}\,\frac{\delta f_1}{f_1} \quad \ldots\ldots\ldots\ 4$$

and (2), treated in a similar manner, gives—

$$\text{abn.} = \frac{v^2}{f_2}A_1 + A_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 5$$

(3) is already adapted to eyepieces, and in it as well as in (5) v is approximately the distance of distinct vision, or more exactly $= \Delta - e$, where Δ is the distance of distinct vision of the final image, and e the distance of the eye from the eye lens.

In (2), for parallel rays, c becomes f_1. To compare the results with the equivalent single lens, (4) gives—

$$\delta\theta^1 = \frac{(d - f_2)^2 + f_1 f_2}{f_2(f_1 + f_2 - d)} \quad \ldots\ldots\ldots\ldots\ldots\ 6$$

and lastly (3), will give—

$$D^1 = \frac{f_1 + f_2}{f_1 + f_2 - d} \quad \ldots\ldots\ldots\ldots\ 7$$

$\delta\theta^1$ and D^1 being the ratios produced by the pair to that of the equivalent lens. All these have been carefully tested, by seeing whether they will give the result which ought to be given by a single lens, such as the eye lens alone, if there were no other, of the equivalent lens, &c.

They will furnish an easy method of comparing the aberrations, &c., of the instruments in common use with any other arrangement that might be proposed. Thus, in a Huyghenian, if we were to reverse the order of the lenses, by which it would become a positive, the distortion will remain the same as it is while the dispersion is only one-third.

Again (to which I would draw attention) if we place the *curved* side of the eye lens towards the eye, instead of the flat side, as is usually done, we shall find that the ratio of the spherical aberration in the first case is to that in the latter in the ratio 5 + 21 : 5 + 81, or 13 : 43. It will be asked, Why, therefore, is it not done? Let us see; and this will introduce us to the necessity of taking into account sometimes further approximations than have been used for the foregoing formulæ. In fact, it will show that we must in some instances take into account the *thickness* of the lenses; but this will in general be only necessary for a near approximation in the case of distortion.

If we examine an object, such as a square of an inch, divided into nine equal squares, with a plano-convex lens of, say, an inch focus, we shall find that when the flat side is turned towards the eye, the distortion, and also the colouring, in consequence of the unequal distortion of coloured rays, is much less than when the curved side faces the eye.

On the other hand, if we examine a *test object* with the same lens, used as a simple microscope, and focus it carefully with rackwork, we shall find (such at least is my own experience) that the details are sensibly better seen towards the centre of the field when the curved side is towards the eye. This is owing to the spherical aberration being so much less, the proportion being 7 : 27 of what it is when the other side faces the eye. But when we come to estimate the distortion, which, as we have seen, varies inversely as the cube of the focal length, we shall find that it is *less* when the flat is turned towards the eye—that is, away from the object or image from which the rays proceed; for when we take the thickness into account, the principal focal length is different, according as the rays fall upon it on one side or on the other. Thus, if t be the thickness of the lens at the axis, f^1 its focal length when the latter is taken into account, and f when it is neglected, we have $f^1 = f + \left(\frac{\mu - 1}{r}\right)^2\frac{t f^2}{\mu}$ (Parkinson's "Optics," p. 93), in which t and f must be measured in the same direction for all kinds of lenses, and r being the radius of the surface which the rays first fall upon, the focal length is greater when the curved surface is turned towards the object, and therefore the distortion is less.

By placing the flat side, therefore, towards the eye, we reduce the distortion in a Huyghenian, though at the expense of the sp. ab., and thus the general field will be better with the usual arrangement, though the definition near the centre wil not be so good, owing to there being less sp. ab. when the flat side is towards the object.

The arrangement generally used, therefore, is that which gives the *least distortion*, but not the least aberration. And this seems to bear out what was said in a previous letter, that in an e.p. the correction chiefly to be aimed at is that of the distortion.

This, it would seem, may theoretically be much better effected when one of the lenses is *concave* and the other convex; in fact, when such is the case, we may find such an arrangement as will render the right side of any two of the equations (1) (2) (3) equal to 0; but not all of them simultaneously.

Proposed Eyepiece.—We may now offer the following for consideration. The first lens plano-concave, the second plano-convex, with focal length *numerically* equal to that of the first, and placed at a distance from it equal to twice the focal length of the eye lens, the curved side of each of them being turned towards the eye, and I would propose to call it an "undistorted eyepiece," not because the distortton is absolutely 0, but because it would seem to be much smaller than that of those in use, and I propose in the next letter, which will conclude the subject, to give some further explanations. **W. G. Penny.**

Errata in Letter IV.—In line 17 of (column 1) from bottom of page, for Gr write G^r. In 6, from top of col. 2, for Br write B^r. In line 22 from bottom, col. 2, for P^3 write F^1.

HARMONY IN NATURE.

[22390.]—Since Keppler "yielded to the secret fancy to write a book," nothing has been proved to move or vibrate in nature inharmonious to its own proportion or that of its surroundings, at least not for any length of time. This is, of course, quite natural, for if we suppose, for argument sake, that in any part of the universe a body were to move or vibrate inharmoniously to its surroundings, it would either be overpowered, or, if strong enough in its movements, must ultimately overpower and direct the movements of other bodies, and so create a new law. This latter hypothesis seems not very probable. From the results of experiments I have made, it is quite clear to me that from the movement of a planet, down to the vibration of molecules, there is no difference excepting the distance and velocity: all follow the same law. Much has been done since Chladni founded our acoustical knowledge: yet, with all that, we have not come to the root, the law. The brothers Weber supposed that the results of all their experiments emanated most likely from one law. They were earnest in their supposition, for all and every movement or vibration of any body or matter follows one law. This I shall prove conclusively at a future day. So far, all seems clear to me; but the organic life presents great difficulty in my study, and the following question has repeatedly come uppermost in my mind—namely, is organic life parasitic on nature, and follows to a certain extent its own law? I feel disinclined to accept this view, because, if it were so, a state of things as above mentioned must ensue. The organic life must either conquer the law of nature, or *vice versâ*. My study has now been for some time in the direction to find whether anything is growing inharmonious to the law of vibration, or to its own constituent parts. Having lately come to a (for me) as yet inexplicable fact—namely, that the sound of the step of the left foot is a semi-tone higher than the sound of the step of the right foot. I have found it in man and horses without an exception. To hear a pair of horses trotting on a wooden road is quite a musical display.

My object in writing this is to see whether our anatomical subscribers can give a reason for this apparently stringent harmony, for which I crave their kind condescension. **J. H. Schucht.**

SUPERFICIES OF THE OCEANS OF THE WORLD.

[22391.]—Allow me to call your attention to an error in the estimate of the areas of oceanic surface in your last issue, Feb. 15th, p. 514, in the article "Superficies of the Oceans of the World," by Dr. Otto Krummel, by Göttingen. These estimates are throughout quite evidently incorrect. This is, I presume, due to incorrect translation (I have not Dr. Otto Krummel's work to refer to); but we find the entire estimate of oceanic surfaces, which is the correct addition of the separate estimates, to be 231,915,950 square miles, and this is obviously much greater than the surface of the entire globe. It may be most satisfactory to give the generally-accepted dimensions, which will show the evidence of the error.

Polar diameter of the globe	41,848,380ft.
Greater equtorl. dia. 194° 23′ to 14° 23′ East Greenwich	41,852,864
Smaller equatorial dia. opposite above	41,834,896

From which we may calculate the mean diameter to be about 7,912 miles. The expression for the area of the surface of a sphere is $4\pi v^2$, when

π = 3·14159 nearly
v = 3,956 miles radius

Therefore the surface is 4 × 3·14159 × $(5,956)^2$ = 196,650,700 miles.

The area of terrestrial surface, as stated in your article, 34,354,950 square miles appears to be correct, by which the oceanic surface would be 162,295,750 square miles. **Wm. F. Stanley.**

THE RECENT COLLISION AT STOCKPORT, AND CONTINUOUS BRAKES.

[22392.]—A collision occurred on the 15th December, at the L. and N. W. station, Stockport, between a passenger train from Crewe and a train of empty carriages which were being shunted into a siding.

The circumstances have been inquired into, and Col. Rich's report is published. There are, however, a few points to which attention should be specially directed. The collision was in a great measure due to the omission of the signalman in Stockport No. 1 cabin to give the Edgeley Junction signalman the "warning signal." This omission led the driver of the Crewe train completely into a trap. We will now consider the brake power upon which the driver had to depend. The train was made up of an engine (No. 1,745) not fitted with any brake; a tender with a hand brake only; three vehicles fitted with Clark and Webb's chain brake, supposed to be under the driver's control by means of a cord; three more vehicles with the chain brake under the control of the guard; and two Great Western coaches without brake power.

When the train approached Edgeley Junction the signals were "on," but afterwards taken "off" for it to proceed. The Stockport "distant signal" was next sighted, and as it was at "danger" the fireman at once attempted to apply the tender hand brake; but this failed, in consequence of the crank on the brake shaft giving way.

The driver reversed the engine, pulled the cord of the emergency chain brake, and opened the whistle; yet in spite of all his exertions the chain brake failed to stop the train, and allowed it to run 1,040 yards past the signal, through the tunnel, and come into collision with the empty carriage train. Nothing is more easy than to blame the engine-driver—and, of course, this has been done by the advocates of the chain brake; but looking at all the facts of this case, I arrive at a very different conclusion. In the first place, the driver was undoubtedly led into a trap by the Edgeley Junction signal being lowered at a time when the line was blocked at Stockport; and secondly, what more could a driver do than apply all the brake power under his control, and reverse his engine?

Your readers are well aware that the chain brake has frequently failed and caused collisions and accidents [illegible] that I [illegible] great [illegible] with an efficient [illegible] without difficulty [illegible] entirely [illegible] the companies [illegible] railway [illegible] with a [illegible] engine [illegible] the [illegible].

Clement E. Stretton.

Saxe Coburg-street, Leicester, Feb. [illegible].

THE WESTINGHOUSE BRAKE DOUBLE COUPLING.

[illegible]—The ordinary single Westinghouse brake coupling is well known to your readers, and was illustrated in my letter in XXXV., page [illegible]. One pipe throughout the train and that a required for the efficient working of the brake, but sometimes from having sustained damage, or in account of not having been replaced when worn out, the indiarubber couplings between the vehicles burst, the result being that a train may be delayed or stopped unexpectedly. To avoid this inconvenience the plan shown in the annexed diagram has been devised. The ordinary single pipe is unscrewed, and the double pipe (Fig. [illegible]) substituted, and screwed to the main iron pipe by means of the projection (A). The box (B) contains a ball-vall (C), which is free to close the passage to either branch. When the train is charged with air the pressure is equal in both hosepipes; but should one burst the ball (C) is instantly forced to that side, thus preventing the escape of air from the main train pipe and the consequent application of the brake.

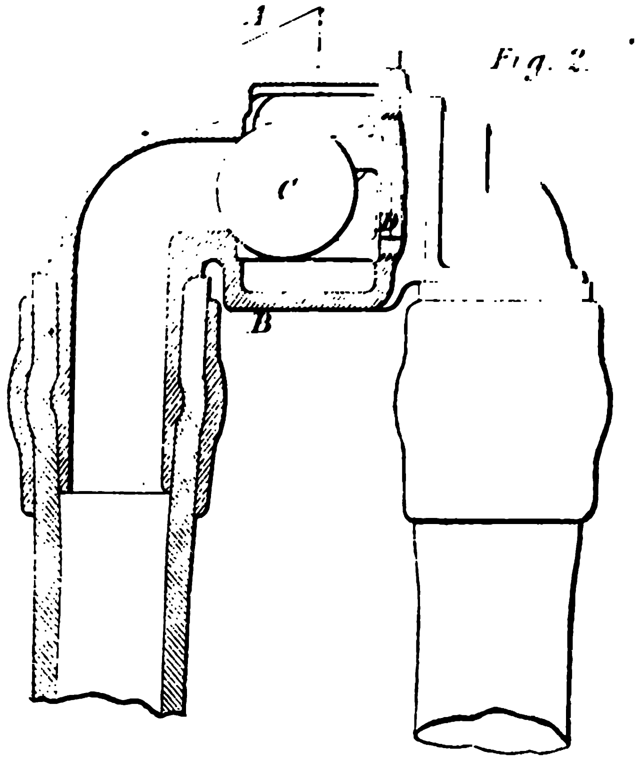


Fig. 2.

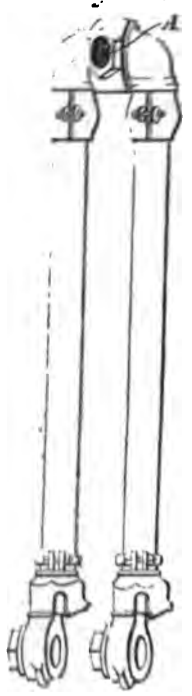


Fig. 1.

To insure both hosepipes being charged with an equal pressure, a small groove (D) in one of the ball seats allows air to pass. When the same pressure exists in both hosepipes the ball will be in equilibrium, and drop from its seat into an intermediate position.

It is probable that all the railway companies will not agree to adopt the new coupling. It is therefore advantageous that the new double coupling can be used with the single pipe hitherto employed, as it is quite sufficient to unite only one of the two couplings to another vehicle, the second being left open. In such a case the coupling to the right hand (when looking towards the end of the vehicle) should be coupled; otherwise, there would be waste of air through the groove (D).

Clement E. Stretton.

Saxe Coburg-street, Leicester, Feb. 8th.

CONCERNING LOCOMOTIVES.

[illegible]—I fear the quotation which Mr. Grey makes from my former letter, will not assist this important discussion. I maintain, Sir, that the speed at which an engine can exert its full tractive force is a matter for experiment; but, most certainly, I did not even make, or think of making, such an absurd statement as [illegible] Mr. Grey [illegible] pressure in cylinders [illegible]. There are [illegible] great [illegible] that [illegible] engine [illegible] experiment. It is a [illegible] what an engine [illegible] they frequently [illegible] companies [illegible] details of the actual working of new engines; [illegible] such details were made, does any [illegible] weigh [illegible] water [illegible]. It is well known that there are engines now at work which have been designed for working certain traffic, yet when tried they fail to perform the duty, yet the [illegible] would prove that they ought to do so. The water space between tubes and around the fire-box, the space in the tubes, diameter of blast pipe, are matters which some seem to think unimportant; but these are just the points which may spoil a design, and to which Mr. Grey does not even refer. If he wishes to enter into a discussion upon these points I shall be happy to give him the benefit of my experience, which extends over 30 years on several railways and in locomotive builders' works.

Historian, M.I.M.E.

Erratum.—In letter on "Ice-fractured Shell," p. 520, last line but two. For "pressure principle" read "pressure per inch."

The Ship-Railway across Mexico.—The ship-railway across the Mexican Isthmus of Tehuantepec is being pressed forward in earnest. The survey of the isthmus has been completed under the care of Mr. Van Buskirk, an eminent American civil engineer. A route with even more moderate gradients and cuttings than were expected has been adopted, and the works have been commenced. Mr. J. B. Eads, C.E., the builder of the great steel bridge across the Mississippi at St. Louis, and whose improvement of the Mississippi navigation has opened up New Orleans to ships of the deepest draught, is now in London concerting business arrangements with shipowners and others, and the probability is that the ship-railway will come under British control, financially and otherwise. Several gentlemen eminent in and in connection with the shipping world are taking the subject up warmly, as this route will shorten the sailing distance between Europe and the North American Pacific coast, including, of course, the British possessions, by more than [illegible] statute miles, and [illegible] miles less than the Panama route.

REPLIES TO [illegible]

*** In their answers, [illegible] fully requested to [illegible] and number of the query [illegible].

[illegible]—[illegible] as I said in [illegible] iron is exactly the same [illegible] by air, but [illegible] length of a [illegible] traversed by a [illegible] "L. F. H." [illegible] between two [illegible] tions. Take, for [illegible] tions per second [illegible] corresponding to [illegible] condensations spread [illegible] and the wave-length [illegible] owing to the greater [illegible] number of condensations [illegible] 17,000ft., and hence the [illegible] would be 531ft., which [illegible] C in iron. As [illegible] of the particles [illegible] much is known; [illegible] Rayleigh has been [illegible] must be exceedingly [illegible]. For air about [illegible] at by his lordship [illegible] audibility of a whistle [illegible] second.—Wm. John Grey [illegible]

[52282.]—**Screw Press.**—[illegible] get a greater pressure than [illegible] pose with the (three per inch [illegible] has, then he might do the [illegible] of turns, by using a screw [illegible] pitch (say two per inch). [illegible] available strength of the lad [illegible] to give the last turn of the screw [illegible] not advise him to alter the screw [illegible] haps the following arrangement [illegible] not, if he will write again, [illegible] shall be glad to do my best [illegible] come them. Let him use the [illegible] and make the block that carries [illegible] it can be moved up and down [illegible] treadle; but it must have a [illegible] rangement, that is, it must have a [illegible] to catch in suitably arranged teeth [illegible] falling, and also to take the pressure [illegible] when it is raised. The method [illegible] then be as follows:—The mould [illegible] be at the bottom of its stroke; [illegible] in the required quantity of clay. [illegible] step on to the treadle, which would [illegible] the mould up towards the stamp [illegible] of the lad had no more effect, the [illegible] into one of the teeth and prevent [illegible] the screw would then have to be [illegible] the stamp down into the mould to the [illegible] tent, and then back again to its orig[illegible] the lad would depress the treadle, releas[illegible] and allow the mould to drop down ag[illegible] get the pot out.—A. Sugden.

[52390.]—**Dynamo.**—To "W. H. [illegible] "W. H. E." mistakes my query, as [illegible] of my F.M. is about ·75 ohm, not [illegible] says; resistance of armature ·5 ohm [illegible] Would it benefit me putting wire on the [illegible] on the legs on each side of F.M. [illegible] much as I can get on close to the pole[illegible]—Dynamo.

[52399.]—**Governors (U.Q.)**—I had [illegible] the above query until I saw it in the [illegible] Queries, or else I would have tried and [illegible] it before. I will give you a rule to find [illegible] of arm of a Porter's or weighted govern[illegible] the number of revolutions, and find the [illegible] a simple governor; then add together [illegible] of the revolving balls, and twice the wei[illegible] centre weight. Multiply the sum by [illegible] found, divide the product thus obtained [illegible] of the revolving balls. The quotient [illegible] will be the height of a weighted [illegible] We will suppose we want a governo[illegible] volve 288 times per minute, the weig[illegible] balls to be 5lb. each, and the centre wei[illegible] 30lb.; required the length of arm [illegible] Then [illegible] the required height [illegible] Dewsbury.

[illegible]—**Gout.**—This question [illegible] Readers of the "E. M." are now [illegible] that gout and rheumatism are diseases [illegible] cess of urate of soda in the system, and [illegible] rational cure is to get rid of this. T[illegible] be fresh be formed whilst you are [illegible] that you already have. Abstinence f[illegible] and alcoholic drinks prevents urate [illegible] forming, whilst the drinking freely [illegible] and the use of hot baths will help [illegible] system of it. Drugs should [illegible] destroy the blood corpuscles, and [illegible] with the urate, which are more difficult of than the original waste, and so prolong se.—T. R. ALLINSON, L.R.C.P., &c.

.]—**Finishing Surfaces.**—Thanks to for his short reply. I beg to say that they done on a milling machine, as I am ac- l with the capabilities of milling machines, been accustomed to working them and other s for some years. Should be very much for a full reply, as I think it would benefit s well as myself. Shall wait patiently, and meone will give the necessary information as possible.—L. T. B.

0.]—**American Organ.**—"Organon" is when, as at p. 475, he makes me say I can eeds as well as anybody. I never made such ard statement. Ready-voiced reeds by the nerican makers are not in the market; there- re out of the hunt. When I said I succeeded ing reeds equal to those I can buy ready , I, of course, alluded to those which are in rket. These latter, I have reason to think, ly set as near as the eye can judge, and are ied and individually corrected in an instru- Are we to consider it an impossibility for a nan, whose daily work is among metals and anism, to do the same thing—that is, copy the and twist from reeds known to be well voiced? writers in "ours," especially Mr. Fryer, to me to make far too much mystery of this g business, apparently taking it for granted beyond the amateur's powers. I refer now ordinary diapason tone, and not to fancy solo Mr. Fryer rightly supposes my experience to ry limited; but as I never miss any oppor- y I may have of examining reeds in good s, and will undertake to accurately reproduce nd and twist, I suppose I may be allowed at a chance of ultimate success. Now, as to the nce of the board upon the tone. Both your spondents seem to consider one board as good other, allowing each to be sound and well to correct scale; they would, therefore, I me, engage to make an equally good organ any such board. But if a given reed sounds ently when placed in various positions on the board, may there not be differences in the it gives when placed on other boards, which possibly be made of other qualities of wood? xperience, if it is short, teaches me that not only oundboard, but in a less degree, the parts of ase also, influence the tone for good or bad. ve," in one of his incomparable letters in a volume, recommends a correspondent to split rd up, and boil the pot with it, if he cannot the reeds speak properly upon it. What does mean, if not the possibility of getting hold of l board? "Organon" raises an imaginary ulty as to telling which are good. The only I can suggest would be to clamp them on a lchest in a temporary manner, and try them a well-voiced set of reeds. I, for one, should ad if "Joiner" would tell us what he knows the soundboard affecting the tone of the ument. Also, his present opinion of the nt of 16ft. tone desirable in an instrument d be welcome. If I remember rightly, his manual has three rows of 16ft. As "Organon" es to know how my board is built, I may tell it is an ordinary three-row, 16 and 8ft. rows to ack and the 4ft. facing front. The half-row 6ft. solo set, set right at the back, and having well. The "Queen's Model" is the same osition, with, I believe, the addition of another solo set. Therefore, I think "Organon" has unduly hard upon me, seeing I erred in such company; but I value his letters none the less at.—J. E. FLOYD.

549.]—**Unfermented Bread.**—In answer to E. L.," I use only unfermented and un- ed bread. The wholemeal flour is simply d with a little salt and water only and kneaded a dough; this is put in tins and then baked. bread is firm and keeps well; I have eaten it three weeks old. Being close-grained, it res thorough mastication, which means proper ivation, and so good digestion.—T. R. ALLIN- L.R.C.P., &c.

654.]—**Point of Greatest Transverse in.**—The calculation on p. 500 only gives the nce of the centre of gravity of the mass from upports, and the point f is not necessarily the of greatest strain.—J. S. C.

654.]—**Point of Greatest Transverse in.**—"Querist" says that I have not answered uery. I say, in reply, that his query admits of nswers, and that I have sent one of them. Querist" place a solid block of stone, accord- the conditions of his query. Then, with the est deflection of the beam mentioned the t of 4½ and 5½ tons is then on two points at 4ft. and 6ft. from each end of the beam.— ER, Accrington.

61.]—**Tar in Greenhouse.**—It is only it is fresh or gives off fumes that it is in- s to plants. Go over it with a hot iron, rubbing well about, and while still soft, dust over slack lime, cinder dust, sand, and anything else that will form a coating. Why did you not paint as others do?—BEGONIA.

[52673.]—**Children Sleeping with Aged Persons.**—This query cannot be satisfactorily answered. Some say that the old being cooler than the young abstract some of the heat from the young, and so cause ill-health. This fact seems to support their view: in childhood the pulse is quick, whilst in old age it is slow. A rapid pulse means increased heat, whilst a slow one means diminished heat. We also know that a certain heat is necesstry for life, and what lowers that heat must decrease or lessen life.—T. R. ALLINSON, L.R.C.P., &c.

[52674.]—**Photo-Etching.**—I think I understand what "F. H." means by etching on copper plate "by the aid of photography." He means a photograph of a line drawing transferred to or photographed on to a copper plate, and the lines protected by varnish, rosin, &c., while the other parts of the copper plate are eaten away by acid. If I m correct, I think he will do well to read up what has been published in connection with photo-zincography, which will give him an idea of how to proceed with copper. I know of no other process of etching copper by the aid of photography.—NUN. DOR.

[52676.]—**Printing Paperhangings.**—The art of printing paperhangings is sufficiently explained in such works as "Ure's Dictionary." If any special point is indicated by the querist as needing elucidation, I will help him; but briefly, paperhangings are made thus: the colours are made by mixing suitable pigments with size; the ground colour is applied by means of a brush, the design by means of wooden blocks engraved to suit, three or more being required to complete anything but the very simplest designs.—NUN. DOR.

[52684.]—**Platinised Silver.**—All that "Gulliver" has to do is to drop in the platinum salt until the silver plate is thoroughly covered with a black coat. I am unable to tell him how much platinum chloride is required per sq. foot, but he can easily ascertain, and need not waste a hundredth of a grain.—NUN. DOR.

[52690.]—**Patent Armatures for Dynamo Electric Machines.**—Legally, you cannot make any patented article; but practically you can, for the simple reason that no patentee would think of bringing an action for infringement unless you interfered with his business. So far as the armatures of any machines of the kind are specified, it would be interesting to learn how many of them are valid patents; but if the Gramme patent is not extended this spring, anyone will be free to use and sell machines constructed according to the specification of Gramme and D'Ivernois, dated 1870.—NUN. DOR.

[52693.]—**Watch Jobbing.**—I am sure that if this querist will only look through his back volumes, he will find the information he requires—not once, but several times.—INDEX.

[52695.]—**Electric Bath.**—There is not much difficulty about fitting one up; but to get it to cure even general debility will be a puzzle indeed.—ANAS.

[52705.]—**Spiral Wood Turning.**—This is done in an ordinary lathe, without slide-rest. The querist should see a turner at work on twisted pillars and table legs, and he might discover how it is done; but it requires a deal of practice. Something about it can be found in back volumes. J. T. M.

[52709.]—**Fire Alarm.**—"Inquirer" apparently wants a fire alarm that can be sounded at one spot, to alarm an area which he does not specify. If steam is always ready, there is nothing better than a powerful whistle or roarer; but it might answer if a strong bellows is used instead, with either a fog-horn, a whistle, or a reed organ-pipe. Failing these, there is nothing better than a bell.—ESSAR.

[52711.]—**Decoration of Jewellery.**—This query is rather a curiosity. What sort of jewellery is it that is to be decorated by means of baths of alkaline plumbates, &c.?—ESSAR.

[52715.]—**Steam Launch.**—"Nun. Dor." remarks on p. 456 that a boat 12ft. by 3ft. will only make from 6 to 8 miles per hour. It would be interesting to know the maximum that this or any vessel is capable of doing, and I should be glad to see how he finds this. Therefore, a boat 24ft. by 6ft. would, say, make 12 miles per hour at its medium rate of progress; and one, say, 300ft. by 96ft. would give 192 miles per hour; and, say, such a vessel made the voyage to America, it would reach there before it started, all things being favourable—a consummation I think that would be very much appreciated, especially by our cousins over the water. Putting joking aside, will someone say what would be the maximum speed to be got out of any of the vessels that run to America, providing they were engined and boilered to their utmost capacity, allowance being made for all contingencies? The answers to these questions being such theoretical and far off from the point. "Nun. Dor." has often made some funny dogmatical remarks in this paper, and seems to think that anything he gives vent to is a settler, and should be accepted as such. People will get egotistical in letter writing until they are brought up occasionally, so I hope he will go into the subject, and show us the why and wherefore of these things.—P. W. R.

[52719.]—**Flooring for Sheds.**—May I suggest that asphalte would be as useful as anything?—T. R. S.

[52720.]—**Telephonic Patents.**—I should think there cannot be much doubt that they are patented in Australia. I don't know, but I should think the cup-and-ball instrument can be used in this country; but Bell's is the only receiver.—S. M.

[52780.]—**Bath Heater.**—"H. H." cannot heat his water quickly by his present system; but if he will look on page v., Feb. 15th, he will find there advertised a water heater which can be made to heat the water at any speed. In the best water heaters, it takes about 1 cubic foot of gas to heat 1 gallon from 50° to 105°; and in the average as usually sold, it takes about 2 cubic feet to do the same work. If, therefore, "H. H." wishes to heat 40 gallons in any specified time, he will need from 40 to 80 cubic feet of gas supplied to the burner in the same time, depending on the class of water heater selected.—T. F.

[52790.]—**Sewing Machine.**—I must thank "W. E. W." for his reply; but it does not give the information I wanted. I am quite aware that it is much cheaper to buy a rotary hook than to make one; but there are numbers of readers who would rather try their hands at making a hook, even if it cost eventually thrice the price of a bought one. To anyone who has a lathe and accessories such a task cannot be one of extraordinary difficulty, if he has only reliable diagrams to work by. These and the requisite information I trust "W. E. W.," or some other reader, will be willing to give.—LOCK-STITCH.

[52792.]—**Steam Launch.**—In reply to "N. R. C." as to the size of engine, I have been looking at a launch about the size I sent sketch of, and I took the measure for "N. R. C." or any other reader it may interest. There are two cylinders, 4in. bore and 7in. stroke, inverting cylinders, direct-acting crank made of 2in. bar; propeller shaft made out of 1¾in. bar; propeller, two blades; boiler from grate bars to top, 2ft. 10in.; diameter, 2ft. This is outside measure. Inside shell leaves 2in. water space all round, and 11in. on the top, but there is a dome on the top of boiler 14in. diameter and 12in. high, steam pipe bolted on top of dome with flange boiler; chimney comes through centre of dome, projecting through about 3in. for strong sheet iron to fit on; propeller 21in. diameter.—THOMAS THOMPSON.

[52792.]—**Steam Launch.**—In reply to "H. H. H.," if a 15ft. launch will do, the sketch I sent will still do to go by: you will only have to make each part to suit yourself. You can easily tell how many ribs you want. For a 15ft. launch, 6in. apart, you will want about 28. You can put them 4in. or 5in. apart if you are not particular to a few ribs, but they are never put closer than 4in. apart. To know what pitch to bend the ribs marked D, nail frame ribs marked *m* temporarily to stem and shaft post on both sides of boat, beginning with top pair, stretch them apart with lengths of any kind of wood (to remain in until all the ribs D are fastened on ribs *m*) 4ft. for about 8ft. length of boat, then let them come closer together gradually towards stem and shaft post; treat second pair the same, only they must be a little closer together—say 2in. or 3in.; do the same with third 2 or 3 closer than second, and the same with fourth pair. Put all four pairs of *m* frame ribs equally apart between top rail E and keel A, then notch bits out of stem and shaft post to let ends of *m* ribs in level, all middle D ribs for about 7ft. or 8ft. length of boat will be same pitch, about the shape of a U, but the rest of ribs at each end of boat where D ribs come narrower, they will be about the shape of a V. If you find any trouble in bending them, draw both ends of each rib in the shape of a half-circle, tie with a strong band, and put them all in a copper or cask of scalding water for an hour, then take one out at a time nail it to *m* ribs and keel. By this treatment you can bend them any shape you like. It will now be ready for planking. For a 15ft. launch I would not have the propeller less than 16in. in diameter. As to the number of blades the propeller should have, it is hard to say: some have 2, 3, and 4 blades both in launches and large steamers. You might try three blades. They will not always tell you at the foundry how to make the pattern so that it will leave the sand. It will cost twopence per pound casting.—THOMAS THOMPSO

[52862.]—**Chemical Problem.**—Neither Grey nor "Student" seem to have noticed the problem, which is one given at the Hono [illegible] Art Department. [illegible] for the hydrogen required [illegible] is two-thirds of 282·34 [illegible] whereas the hydrogen added [illegible] vols. There must [illegible] in correcting the proof [illegible], I expect.—C. J. Wood-[illegible]

[illegible]—**Feed Pump.**—In cases where the [illegible] is any fractional part of a foot, [illegible] a decimal by dividing the [illegible] denominator, so with the stroke [illegible] should have the decimal number [illegible] = ·06. Then, 4 × 4 = 16 × ·034 = [illegible] × 30 = 18·452 or nearly 18½ [illegible] I had not noticed your query, [illegible] Economiser." I am afraid I cannot give [illegible] information, for all I have the charge of the same, I never had any trouble with the caps or covers. I should try to get them off by the following:—Thoroughly clean round the outside edge of cap, and then get some turpentine put well round edge for, say, a day or two before you want to get them off; then screw off the nut and fasten a piece of twine or wire to the thread of the bolt to prevent bolt from dropping inside of pipe, and keep tapping the cap with the hammer. Of course, you could lower the bolt inside of pipe, and insert a lever inside of bolt hole, and remember that perseverance overcomes difficulties.—FIRER, Dewsbury.

[illegible]—**Cough Cure.**—"David" evidently knows nothing of physiology, nor has he perhaps seen the article in the "E. M." of Dec. 21, 1883, copied from the *Lancet* (on coughs), else he would not ask the question he does. "David" wants a universal remedy for coughs of every kind. This is an impossibility, considering that a cough may be due to one of many causes. It may be due to acute or chronic lung disease, to inflamed throat, to a diseased heart, to an aneurism pressing on the laryngeal nerve, to some irritating food in the stomach, &c. This should show "David" the uselessness of his inquiry, and instruct him that a cough is only a symptom of disease elsewhere. Coughs can be stifled, and patients as well, and coughs can be stopped, but the breathing made so difficult that the cure is worse than the disease. So [illegible] stick to your trade. It takes men [illegible] medicine to use drugs properly in [illegible] You may do much mischief in [illegible] kind efforts.—T. R. ALLINSON, [illegible]

[illegible] **Governors.**—The size and weight of [illegible] depends upon the nature of the [illegible] to transmit the agency of the [illegible] throttle-valve. An increase in the [illegible] gives the governor more [illegible] the throttle-valve; but it [illegible] way affect its working. I [illegible] balls you mention, one is [illegible] or weighted, [illegible] are with ample. I [illegible] with the governor [illegible] Dewsbury.

[illegible] **Governors.**—[illegible] weight of the balls [illegible] the least. Each [illegible] a number [illegible] particle of [illegible] attached to [illegible] overcome the friction [illegible] on the steam [illegible] thereto. Though [illegible] centripetal force, [illegible] in the same proportion [illegible] Browne, C.E.

[illegible] **Lights.**—The angle is [illegible] light, [illegible] not forget what I [illegible] is not always [illegible]

[illegible] **Pressure.**—It is difficult [illegible] from the [illegible] atmosphere is only [illegible] quantity of [illegible] by doing [illegible]

[illegible]

[illegible] on the dynamo, the current of which it is measuring, it is, on the contrary, wound with a wire of as low a resistance as possible; indeed, the conductor often consists of a simple broad strap of copper that offers an inappreciable resistance to the passage of the current, in front of, and parallel to which, is pivoted a small magnetic needle, which tends to turn at right angles to the current, and as the angle is directly proportional to the quantity of current, it is easy, after once finding how far a current of known strength turns the needle, to calculate the strength of an unknown current. An instrument of this class has, however, one disadvantage—viz., as the needle becomes after a time less magnetic, it is necessary to occasionally take a fresh reading with a current of known strength, to recalibrate it. There is another class of instrument which is constant, and in this form a suspended conductor is hung at right angles to a fixed conductor, through both of which the current to be measured passes; the current tends to turn the suspended conductor into the same plane as the fixed conductor, and the dynamic force it exerts by this tendency is measured by the torsion of a spring, and from this the strength of the current is calculated. Such an instrument is Siemens' electric dynamometer.—ELECTRICIAN, Dublin.

[52927.]—**Watch Work.**—After you have taken your watch to pieces, try the pillars and see that they are not loose; examine the pinions and see that they are not loose, and especially the escape-wheel, as that is very often loose. See that there is no bur in the lever; rub it over with your burnisher. Mind that your staff pivots come far enough through the jewel-holes and round the tops of the pivots; examine the jewel-holes and endstones. I should think the stopping is caused by the suspension and detent not working when being wound up. Mind that the inspring does not rub on the barrel cover, and the bottom of the barrel does not rub on the centre wheel; try all the depths and endshakes, and see they are all upright. If everything is nice and free, I don't see what can stop it varying in action. —DUM SPIRO SPERO.

[52943.]—**Electro-magnets.**—Thanks to the willing hands who replied to my query on p. 504. I do not want nature to alter her system for my bit of apparatus; but a more general practical knowledge and compliance with the laws of nature among the English people would not hurt them. I confess my ignorance of the existence of residuary magnetism in electro-magnets, and regret to learn it is inevitably a law of nature or nature's system, as "Sigma" terms it—a thorn in the flesh for which there is no remedy. It is the holding power only I want to utilise, and not the attractive power, and for the wellbeing of my apparatus the residuary magnetism is highly pernicious. I note the magnets should be made of soft iron, say, Swedish iron, and thoroughly annealed. The tinning or deposition of copper on the poles of the magnets deteriorates the useful effect.—C. B.

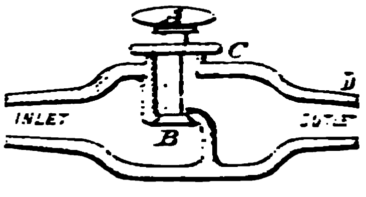
[52950.]—**To Violinists.**—If your hands perspire much, you had better use acribelle or metallic E strings, and steep your hands several times daily in a saturated solution of alum: but possibly the breakages may be caused by your nails being too long. Do not be discouraged at your inability to stretch the little finger: it is a difficulty experienced by all beginners, and can be overcome by practice and perseverance. I would advise you to work diligently at the following exercise on the E string, both with detached and legato bowing, very slowly at first, but increasing in rapidity as proficiency is attained: E B, F sharp B, G B, A B, A B, G B, F sharp B, E B. This exercise may be repeated a fifth lower on each of the other three strings. I will gladly give you any further help in my power, and would remind you that Tartini scarcely touched the violin till after 30 years of age, and that Spohr's best pupil began at 21.—WAR.

[52959.] **Beer in Scratch-brushing.**—Try strong soda-water, common washing soda, or nice soapy water rather warm. I have used both for three years past, and find them answer very well; use a cork to procure froth.—DUM SPIRO SPERO.

[52959.] **Beer in Scratch-brushing.**—The replies to this may be all right; but I think the mixtures would be no improvement on beer. The London jewellers generally use size. I have for several years used size made from the best light-coloured glue, made so thin as to have no smell when it is cool, and to run freely on to the brush. I put 2oz. or 3oz. in a saucepan with a quart of water, and simmer over the gas stove. It is ready in 10 minutes, and if too thick to run freely add warm water. It must be very thin, or will clog when cold. You will find this quite free from objectionable smell, such as beer and vinegar have.—J. F. A.

[52961.]—**Hand Water Tap.**—Thanks to "T. F." and "Sigma" for replies; but their suggestions do not meet my requirements. The hand-tap must be such as I can (having only one hand at liberty) lift, use, lay down, lift and use again a good few times, perhaps in the course of ten minutes, the flow to cease instantly wh[illegible] use. An ordinary mouth blowpipe w[illegible] purpose admirably if there could be fixed [illegible] perhaps some kind of valve which could be [illegible] trolled with thumb or finger so as to [illegible] ously turn on and shut off the flow of water [illegible] it at will.—ARNOLD WARBURTON.

[52961.]—**Hand Water Tap.**—W[illegible] constructed on the same principles as th[illegible] at some of the railway station lavator[illegible] your requirements: By pressing a small [illegible] front of tap the stream of water can be [illegible] at will. (See sketch.) A, small knob of brass [illegible]



piece of brass wire screw in [illegible] end of wire small leather washer is [illegible] slight pressure on A the water passes [illegible] B: C, gland for packing: D, tap ends [illegible] on rubber tube.—WILLIAMS.

[52962.]—**G. W. R. Engines.**—55 Queen [illegible] single-wheel double-framed inside-cylinder [illegible] engine, having 7ft. drivers, 17in. by 24in. cylin[illegible] It was built at Swindon in September, [illegible] the designs of the late Mr. Joseph Armstrong [illegible] is stationed at Paddington. Nos. 483 and [illegible] 490) are 6ft. four-coupled passenger [illegible] having inside cylinders 16in. by 24in. The[illegible] built at Swindon in 1869. 55 is a four-coup[illegible] passenger engine, having driving wheels [illegible] diameter, was built at Swindon in Octobe[illegible] and is stationed at Reading. [illegible] four-coupled passenger engines, were bu[illegible] Wolverhampton in 1864, and most of them [illegible] been recently rebuilt there. 55, Queen, [illegible] 481—490 are of the late Mr. Joseph Armstr[illegible] designs. 55, Queen, has been lately improved [illegible] Mr. W. Dean, now having plain splashers [illegible] brass dome. It also has the new type of [illegible] adopted by Mr. Dean.—J. E. SPENCER.

[52963.]—**Weight of Coaches.**—The L. and N. W. Railway Company's six-wheeled coaches weigh respectively 10 tons.—J. E. SPENCER.

[52971.]—**Antimonial Lead.**—Dissolve a portion of the alloy in as little nitric acid as possible with the aid of heat. When all is dissolved, boil and then add a large excess of pure water, which will ppt. the antimony as an oxide and filter. Evaporate the filtrate to less than the original bulk, and treat again with water: this will ppt. all the antimony that remained in the solution after first treatment with water. The two precipitates washed together, may then be dissolved in HCl and a piece of clean iron immersed in the solution will ppt. the antimony in the metallic state. The filtrates and washings mixed together may be evaporated to dryness, and the lead weighed as nitrate ($Pb2NO_3$). This may be reduced to metallic lead by fusion with charcoal in a Hessian crucible.—AN OLD APPRENTICE.

[52980.]—**Crescent Moon.**—I once saw the "young May moon" under 30 hours old, the prettiest imaginable tiny thread of golden light. It was in the year 1833, taking my first journey up to London by the North Devon coach. We had a three o'clock dinner at Taunton, then my friend and I rode outside as far as Salisbury. The evening was exceptionally clear and summerly—thus it was that I could watch the western sky. Reference to an almanac for that year will verify my statements; but the impression on my memory is that the moon changed early on Monday afternoon, say, near six o'clock, and I saw it on Tuesday evening, soon after nine o'clock, at 29 hours old. I believe that Tuesday was the 19th of May. I have frequently seen the moon under 40 hours old—never but the once under 30.—H. O'B.

[52980.]—**The Crescent Moon.**—If the point of this inquiry lies in the comparative rarity of favourable opportunities for astronomical observations generally, owing to "our wretched climate," the instance recorded by your correspondent may possibly be deemed "noteworthy"; otherwise I think it can hardly lay claim to such distinction. After the turn of the year, and during the early spring months, the young crescent moon has considerable northerly declination, as compared with the sun, and may then frequently be observed much within the interval after conjunction, which he describes—viz., 38 hours. In the present case her early appearance was favourably influenced by her being at the time near the point in her orbit of her extreme north latitude, and under similar circumstances I once succeeded in obtaining a view when she was less than 22 hours old. In Drew's "Manual of Astronomy" an instance is given of an observer having noticed the waning crescent near conjunction in the morning, and the waxing crescent in the evening of the following day. I need scarcely say that this could hardly have been observed in our latitude.—W. T. N.

[52980.]—**Visibility of the New Moon.**—It is not often that the new moon can be seen with the naked eye when less than 38 hours old, the conditions being generally unfavourable. But occasionally in the spring months the narrow crescent of our satellite may be distinguished much earlier than this. On March 30, 1881, I saw the new moon at 7h. 10m. when she was only 20 hours 38 minutes old; and on June 4, 1875, at 9h. 10m. when only 22 hours 49 minutes old. I am not aware that a "younger" moon than that of March 30, 1881, has ever been observed in this country. The Rev. S. J. Johnson, in his work on "Eclipses, Past and Future," p. 116, says:—"It is a curious point to notice how soon we can see the crescent of the moon after new. In the spring a casual observer may catch sight of it, when very clear 24 hours afterwards, but I have hardly ever detected it younger than this. A case is related of the moon's thin crescent being seen early one morning before sunrise and after sunset next day. But in the torrid zone Vespucius is said to have seen the moon to the east and west of the sun on the same day." I know of few more interesting sights with the naked eye than is afforded by the extremely delicate crescent of the moon when between one and two days old.—W. F. Denning, Bristol, Feb. 11.

[52981.]—**Bichromate Battery.**—The solution should remain unchanged and good for any length of time when not in use. Only when (after more or less work) it becomes of a greenish colour is it spent and useless. The failure of the light might have been due to the polarisation of the battery plates, or to local action in the cells owing to defective zinc plates. I should recommend "M. A." to examine the zinc plates of his battery, which, probably, need reamalgamation.—Student.

[52982.]—**Gramme Dynamo.**—Size of wire for field magnets, No. 16; weight, about 5lb., or 1¼lb. on each division above and below. For armature, about 4lb. No. 20, in 16 sections of ¼lb. each. This will absorb rather over one man-power, say ¼ horse, and ought to light well four Swan lamps of 10 c.p. Please publish result, and oblige all.—S. Bottone.

[52982.]—**Gramme Dynamo.**—You do not say whether you wish to wind your machine as a series or shunt dynamo; but you will find a series machine most useful for general experimental purposes. Wind A with No. 20 double s.c., and put as much No. 18 on F. Ms. as will just equal the res. of A. You can find the quantity required for F. Ms. after you have wound the A. by looking at a table of resistances, and remember that the res. of A. is equal to half the weight of wire wound on. About four 5 c.p. lamps; about one man power; sixteen, the more the better. When you have it finished send result.—W. H. E., Coventry.

[52986.] — **Lightning Conductors.**— The Houses of Parliament are protected by conductors of copper tube, some 2in. in diameter, and ⅛in. thick, fastened together by solid screw plugs and coupling pieces secured to the building by metallic staples. This was the recommendation of Sir W. Snow Harris in 1855, and was carried out by the Board of Works at a cost of £2,314. The plan was costly and somewhat faulty, on account of the large number of joints. These conductors were recently tested and repaired by a competent electrician If "Conductor" will write to 11, High-street, Walthamstow, E., further information will be willingly given by—Samuel Vyle.

[52991.]—**Metal Turning.**—I think you will find much, if not all, the information you appear to want, in a series of articles on "Tools" which will shortly be issued.—J. H.

[52994.]—**To S. R. Bottone.**—Prime cost, home made, about £5. Hourly cost to drive it, by the cheapest battery that will do the work, comprising attention, 6d. My judgment advises—*Don't.*—S. Bottone.

[52995.]—**Pressure of Sea Water.**—A cubic foot of sea water weighs about 65lb., hence, for every foot of descent there is a pressure of ·451lb. per square inch over and above the pressure due to the atmosphere on the surface. The querist can surely calculate the pressure at any required depth from the above figures.—Wm. John Grey, Elswick Science School.

[52995.]—**Pressure of Water.**—As the pressure of water on the bed of the sea is only another term for the weight of the water on a given area, and as the quantity of water above us increases as we descend, it follows that the pressure increases in proportion to the depth. As sea-water weighs about 64·18lb. per cube foot, the pressure on a square foot at the depth of 100ft. is about 6,418lb. —J. S. C.

[52995.]—**Pressure of Water.**—The pressure at the bottom is in proportion to the depth. The general rule is to multiply the area in feet, by the depth in feet, and the result by 62¼ (the weight in pounds of a cubic foot in water), the result being the pressure in pounds, e.g., the pressure of 1 square foot at a depth of 1 mile:—1 × 5280 × 62¼ = 328,660lb., or about 146 tons. In the supposed case of a bladder, the pressure would be exerted equally over all the area of it in the above proportion, that is, 146 tons per foot supl.: or say, one ton per inch supl. at the above depth, which would compress the air contained in the bladder into about $\frac{1}{130}$th of its bulk at the surface. Material of bladder and temperature are disregarded.—Ditton.

[53000.]—**Slide-Valve Motion.**—It is Joy's valve gear, illustrated on p. 411, last volume. I suppose you know there is a royalty to pay. See p. 224, ante.—Essar.

[53002.] — **Strength of Beam.** — The usual practice is to consider that a uniformly distributed load may be twice the safe load in the centre, and as the strength varies in proportion to the length, the beam at 12ft. space would carry the same load (4 tons) uniformly distributed, as the beam at 6ft. would carry at the centre.—Ditton.

[53002.]—**Strength of Beam.**—If a beam can carry 4 tons in centre of 6ft. span, a beam of same section can carry 2 tons in centre of, or four tons distributed on, 12ft. span. The weight is inversely as the span, or weight × span in any case = weight × span in any other case, the section remaining the same. But when the span is large in proportion to the depth of beam, the stiffness as well as the strength must be considered.—J. S. C.

[53002.]—**Strength of Beam.**—Ought not "E. E. R." to have given the weight of the beam itself? If the beams are of equal and similar section, the equal distribution of the load would exactly compensate for the doubling of the length. But the weight of the beam itself is now doubled, and so the load will have to be lessened in proportion to that weight. The longer beam will have twice the resilience of the shorter one, but that may be quite useless, for "E. E. R.'s" load may not bring resilience into play. As the safe load is some fraction of the breaking weight, I do not see how increase of span can affect it, except, of course, in the same way it affects the breaking weight at the same time. I should like to hear what some of our practical friends say about it.—C. N., Egstow.

[53002.]—**Strength of Beam.**—For similar supports and conditions of loading, the strength of a beam varies directly as the breadth and square of the depth, and inversely as the length; the formula being—

$$S = \frac{k\,b\,d^2}{l}$$

where k is a constant, depending upon the nature of the beam, and upon the units employed. As regards the position of load and supports, we have—

	Strength.
Supported at one end, loaded at the other ..	1
,, ,, load distributed	2
,, at both ends, loaded at centre ..	4
,, ,, ,, load distributed ..	8

Assuming that the beam in question is supported at both ends, it would, when doubled in span, take only half the load at centre; but it will bear the same load if distributed.—Wm. John Grey, Elswick Science School.

[53003.]—**Soda and Alum.**—The change on mixing solutions of caustic soda and alum consists in the precipitation of aluminium hydrate, and is expressed by the following equation:—$Al_2K_2(SO_4)_4 + 6NaHO = Al_2H_6O_6 + 3Na_2SO_4 + K_2SO_4$.—Wm. John Grey, Elswick Science School.

[53003.]—**Soda and Alum.**—If a solution of sodic oxide (Na_2O) be added to a solution of alum ($S_4O.Amo_2Al_2O^6$), a precipitate is formed, viz.:—Aluminic hydrate (Al_2HO_6). This precip. is soluble in an excess of sodic hydrate (NaHO), but may be reprecipitated by ammonic hydrate (ordinary liquid ammonia) AmHO.—C. N., Egstow.

[53003.]—**Soda and Alum.**—If "Querist" means washing soda by "soda," which contains hydrate as well as carbonate, the ppt. would be aluminic hydroxide ($Al_2(OH)_6$) or hydrate. The reaction would be: Sodium hydrate and aluminium and potassium sulphate, forms sodium sulphate and aluminium and potassium hydrates.—R. A. R. Bennett.

[53005.]—**California.**—If "J. M. M." will send to Mr. Kingsbury, 41, Finsbury Pavement, E.C., he can obtain a list of instructive works on California, which will probably help him. Your correspondent must, however, remember that the skill which is paid for here is not in such demand there, for excellent fruits grow wild. Florida seems to be best for oranges, but California is in the first rank for the vine, and raisin raising is a rising and remunerative industry. The one thing needful is capital to start with; then the emigrant should do well.—N. E. Child.

[53007.]—**Electric Gas Lighter.**—This query was actually answered so recently as p. 436, reply 52660. As stated, it is understood to be the chloride of silver cell, and directions for making have been given several times. See p. 224, this volume.—Nun. Dor.

[53009.]—**Magneto-Electric Machine.**—See that the slits between commutator are free from metallic particles, also test for insulation. Your magnets want remagnetising.—W. H. E., Coventry.

[53009.]—**Magneto-Electric Machine.**—Cannot say for certain what is wrong with your machine without seeing it: but, probably, one or both of the commutator springs, or the contact-breaker spring, has got bent so that it does not rub on commutator, &c.—F. R. Street, Hitchin.

[53009.]—**Magneto-Electric Machine.**—1st. The magnet may now be too weak. Such a magnet ought to pull 10lb. 2nd. The fine wire round the armature may be broken at some point. Test this by sending a current from a battery through the wire into a galvanometer. 3rd. The silk covering may be damp, and the insulation imperfect. Dry it by leaving it over the mantelpiece for several days, and try again. 4th. The springs (brushes) which take off the current do not press properly on the split ring. 5th. The brushes press continuously, and are not furnished with interruptor: hence current, but no shock.—S. Bottone.

[53015.]—**Expansion.**—(1) The rate of expansion of gases, which is uniform for all degrees of heat, is $\frac{1}{273}$ of the volume of the gas at 0° C. for each degree increase of temperature. Thus, 273 cubic inches of a gas at 0° C. would measure 274 cubic inches at 1°, 275 cubic inches at 2°, &c. The expansion for each degree of the Fahr. scale is $\frac{1}{490}$ of the original volume at 32° F. The law relating to pressure is that "the volume of a gas is inversely as the pressure." Thus, 100 cubic inches of a gas under a pressure of 30in. would expand to 200 cubic inches were the pressure reduced to one-half, and shrink, on the contrary, to 50 cubic inches if the original pressure were doubled. The standard pressure at which gases are measured is 760mm., or 31in. of the barometer. (2) Liquids vary exceedingly with regard to expansion. They expand more rapidly at a high than at a low temperature. (3) Sulphuric acid of sp. gr. 1·85, between 0° C. and 100° C., apparently expands about $\frac{1}{17}$.—Student.

[53016.]—**Battery for Electric Light.**—Your 40 cells will give you an E.M.F. of 76·0 volts, and a current of about 3½ ampères. If you join your cells up for quantity, you will get 38 volts and 7 ampères, which I think would do for ¼in. carbons, and give you a light of 90 c.p. to a 100. You will find that to manipulate so many cells will be a great deal of trouble and time, as it is advisable to reamalgamate your zincs for every 30 hours of working. If you really mean to go to so much expense and trouble, why not use aqua regia? you will find it cheaper, and give the same E.M.F. Put in the outer jars 10 parts of water, and 1 part of HCl (hydric chloride), and in the porous 1 part of nitric and 3HCl (aqua regia). You ought to get N_2O_5, 14·50 s.p., 4½d. per lb. and HCl 1d. per lb. This solution will not smell so much when working as the ordinary Bunsen form.—G. D. Goold.

[53019.]—**Fixing Windows.**—If A. Lloyd inquires of R. Adams, engineer, Great Dover-street, Boro', he will find, I think, just what he requires, in a reversible sash.—Ditton.

[53020.] — **Who Discovered the Lunar Clefts?**—Many thanks to "F.R.A.S." for replying to my query *re* Crescent Moon; also to Mr. Gwyn Elger, whose beautiful drawings of the lunar surface enrich the astronomical section of the English Mechanic. Apropos of who first discovered the clefts, I venture to note that in Hevelius' lunar map (published half a century before Cassini's) there are drawn three parallel rills. They are to the west of what he calls Mons Climax, and run northwards into the Mare Syrticum. They are designated Fluvius Nilus. I am puzzled to identify these objects in either Webb's or Beer and Mädler's smaller chart. They must, however, represent valleys or clefts which "old Hevel" actually saw, and if the latter, then the date of the discovery of the lunar rills is carried back to within fifty years of the invention of the telescope.—Arthur Mee.

[53022.]—**Black Colour for Cement.**—If A. W. Donald lays his first bed with blacksmiths' ashes and cement, and then finishes with cement and blacksmiths' dust mixed, two of dust and one of cement, he will get a black floor, and one which will polish. I should advise him to have the first bed 1in. thick, and the finishing layer ¼in. thick. He could get the ashes and dust from any blacksmith's shop.—H. E. T.

[53024.]—**Wimshurst Influence Machine.**—The best cement for fixing the sectors to the glass plates is "Kay's Coaguline Cement," to be obtained of almost any chemist. A 6d. bottle will contain more than enough for the job. Carefully

.]—**Patent.**—In a certain process the end in hitherto been obtained by means of rollers or or revolving arms, all of an unyielding nature, e same means, mounted on spring or other flexi- ings. I propose to substitute brushes for this , and want to know whether I can entirely pro- ir use in this direction, that is in all possible : combinations, to prevent others using brushes purpose in any form, or can I only patent their ich a manner as may at the moment occur to me eadiest way of doing so?—H. J. J.

.]—**Eau de Dr. Pierre.**—Can any one give formula of this preparation? It is one of the ds for the mouth and teeth I have met with; but French manufacture, and subject to duty, the England is very high. I should, therefore, like something similar myself, if any reader could e?—Ariel.

.]—**Light for Dark Room.**—I am fitting up oom for dry-plate work, and would like to know e light would be safe to work by. Would some eader say if the following would do? Window ast, 1ft. square; outside is thick plate glass; next ss; then white glass covered with yellow paper d. Or, should I have two pieces of ruby glass?

.]—**Chemical Analysis.**—Will some reader give the details of process for the separation of of the following acids in an organic salt—Formic, xalic, tartaric, and salicylic acids, as required by nce and Art Department in the elementary stage ical organic chemistry?—Young Student.

.]—**Legal.**—To Mr. Wetherfield.—A., a an in Scotland, wishes to marry B., an English- resident in London. As the marriage laws in countries are very different, please say the best cal and expeditious course for A. to pursue. The e to take place in London.—A. Wilson.

.]—**Varnish.**—Can any of "ours" inform me al varnish that will not dry is to be treated? I king terebine with it, and find this answers toler- l; but I should like to know whether sugar of itharge would be better? Also, is it necessary e varnish should be heated when any of these ces are added?—C. E. L.

.]—**Collodion Emulsion.**—On p. 517, Vol. ., Capt. Abney speaks of collodion emulsion as itable for landscape work. Will some one kindly tructions for making the emulsion, and state it will keep after the plates have been plated?—

.]—**Surveyor.**—Will some one give me the ployed by contractors and others by which they a few minutes (upon dimensions being given he estimated cost of a house, barn, or other ?—Gerald Harley.

.]—**Bunsen or Grove?**—In one book I have E.M.F. of Grove's cell is given as being 2·0 volts, Bunsens as 1·80 volts; whereas in Ganot's s" the Bunsen is given as 1·87, and the Grove 1·82. I should be obliged if any of "ours" will which is correct, and which is the best battery wo for ordinary purposes?—L. W. Willis.

.]—**Dynamo Machine.**—Will Mr. Lancaster, ," or some other valued correspondent, kindly e by saying what results I ought reasonably ex- m such a machine I have completed on H prin- follows? Armature 6in. by 2in., 1lb. No. 18, ·55 .M.'s 5lb. each No. 14, ·72 ohm. I get a current; not think it satisfactory. I drive it from lathe; uncertain as to whether I get enough speed or I was unable to get so much wire on the arma- I expected, so as to get resistance higher; but is will not materially affect the result. What he conditions of the external circuit to be to est results?—A. W. Lambert.

.]—**Pressure of Blast.**—Could an ordinary last be utilised for a Bessemer steel converter on scale, say half-ton to a ton of metal? If so, how he tuyeres be arranged?—Ariel.

.]—**Sprained Wrist.**—Some four or five years rained my left wrist, and since then it has always newhat weak, and generally after a few days' , in the way of cycling or boating, will show itself ppearance of a large bump, and will not disap- in unless I allow it considerable rest. Will some ly advise me how to get rid of it altogether, if ? as it is a source of great discomfort and annoy- me—more especially as I wish to go in for gym- this spring.—Mosaic.

.]—**Analysis of Stone, &c.**—Can any of give me the name of a book treating on the ana- rocks, stones, &c., particularly limestones—quali- nd quantitative?—Spark.

.]—**Lapidary Machine.**—Will some Scotch reader furnish me with a plan of the above for and polishing stones and shells, &c.? I believe be bought about Aberdeen, with small engine, ething like £2 a piece. Also description how to e.—Spark.

.]—**Organ Stop.**—I beg to ask advice on the g:—The Stopped Diapason treble of my chamber which consists of wood (compass tenor F to C, 3½ , has a very dull and husky sort of tone. I have inking of removing this and replacing it with a Gedackt of metal. Now the stop at present adds dy to the tone when the remaining stops (metal) n; and what I want to know is—Will I get the dy from the Lieblich Gedackt? Also, has the metal employed as much to do with the tone of pipes as it has with open pipes?—Cymro.

.]—**Concerning Locomotives.**—To "His- "—Will "Historian" kindly give the stroke of ress with 6ft. 6in. drivers which can exert full force at 60 miles per hour (letter 22326, p. 499), does diameter of driver alone affect the speed at ull tractive force can be exerted, or does not f stroke affect it also?—J. L. C.

[53066.]—**Softening Malleable Castings.**—Will any one tell me how to soften a few light malleable castings, at the smallest possible cost, on the best principle out?—E. Willoughby.

[53067.]—**To Mr. Allen, Mr. Grey, and Others.**—Will any of these gentlemen kindly tell me where I can get any information as to the analysis of soda waste? Also any description of the processes in use for the utilisation or the recovery of sulphur therefrom.—H. C.

[53068.]—**Indicator Diagram.**—Will some correspondent kindly answer following? Explain a method of combining the indicator diagrams in a compound engine with cranks at 0° and 180° apart, but without an intermediate reservoir, so as to obtain a single expansion diagram. Having done this, how is the diagram of turning pressure on the crank shaft set out?—C. N., Egstow.

[53069.]—**Estimation of Chlorides.**—Will Mr. Allen, or other of our chemical readers, explain how chlorides can be quantitatively estimated by means of mercuric nitrate? Also the quantity to be taken to make a normal solution? I tried to dissolve the mercuric nitrate in water, and found it only very slightly soluble.—Hydrargyrum.

[53070.]—**Iron Cement.**—Would any of your readers kindly furnish me with a recipe for making a good cement that would firmly secure an iron screw when screwed into iron?—something that could be easily applied when melted, and after being left a day or two to dry, prevents its being unscrewed, except by special force.—Inquirer.

[53071.]—**Empties.**—Perhaps some of your legal correspondents will be good enough to enlighten me on the following:—I live on a line of railway, and frequently have to send empties to London. They are delivered by me at the nearest station, and receipt obtained for them; but the railway company fail to deliver. Can I sue them through the station-master who receives the goods in the country, or must I do so in London? In the latter case, it would be preferable to lose the goods.—Cairo.

[53072.]—**Mill Gearing.**—The gearing at our mill is driven with ropes off the main driving pulley on the crankshaft. Can any of our readers tell me why some of the ropes in working wear on all the surface?—that is, they twist round in working, and the others do not: they only wear on two sides. I should be very glad if any one would tell me how to stop them that wear on all the surface in twisting round, and make them wear on two sides only—that is, where they grip the pulley in working.—J. S.

[53073.]—**Upright Frame Saw.**—Will any reader say which is the best plan to erect upright frame saw to be used for cutting deals into boards? The building is constructed of wood. The saws to be driven from overhead. Diagram would be acceptable.—Pine Deal.

[53074.]—**Painting Terracotta.**—Wanted composition of the medium known as "Veloutine," used in terracotta painting. Also medium for painting in oils on silk or satin.—Terracotta.

USEFUL AND SCIENTIFIC NOTES.

The New Skrivanoff Cell.—The following description of this cell is being circulated; but it will be seen that it is simply a chloride of silver cell, with caustic potash instead of chloride of zinc. Two of the cells, contained in ebonite cases buckled to the belt of the performer, keep a star light going, and the light is readily controlled by the wearer. Each cell consists of a zinc plate bent into the form of a U, and holding in its inside a plate of silver coated with chloride of silver. The zinc plate forms one pole of the cell and the silver the other. A solution of caustic potash—75 parts potash to 100 water—is poured in, and as a porous diaphragm, the chloride of silver is covered with parchment paper. The vessel is of ebonite, with closed mouth, which, however, is opened when fresh liquid has to be put into the cell. This is necessary after every hour's run, and the chloride of silver has to be replaced after three or four hours' of use. The cell is thus expensive; but this is of minor importance in theatrical work as compared with its small size and weight—100 grammes (3½oz.)

The *American Manufacturer* (Pittsburgh) says:—"Messrs. McIntosh, Hemphill, and Co. are interested in the construction of a tank car for the transportation of natural gas. The car is being built at the Swissvale Car Works. It is an ordinary flat car containing a cylindrical tank of ½in. steel, 10ft. in diameter and 35ft. long. The tank is to be filled at the Tarentum wells, and is capable of containing 20,000 cubic feet. Mr. Hemphill considers the scheme a practical one. At any rate he proposes making the trial."

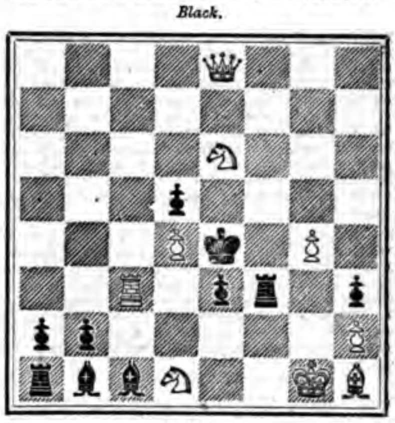
It appears that the Arlberg Tunnel will be finished by the end of May, and the Arlberg Railway by the end of October. The measurements which have been made since the meeting of the two headings of the tunnel show a horizontal divergence of 43 millimetres. A re-levelling from the central part of the tunnel also shows that the datum adopted at the eastern part of the works has an elevation of 164 millimetres above that of the western end. The total length of the tunnel is 5·68 metres less than was estimated before the boring was finished.

CHESS.

All Communications for this department must be addressed to J. Pierce, Bryn Rhedyn, Llandwrog, Carnarvon.

PROBLEM DCCCLXXV.—By G. J. Slater.

Black.



White. [9+10

White to play and force Black to mate him in three moves.

Solution to 873.

White.	*Black.*
1. Q-K B 2	1. Anything
2. P or Kt mates	

(Two variations.)

NOTICES TO CORRESPONDENTS.

Correct Solutions to 872 by R. A. Bennett, Dicky Sam, and F. Kenney; to 873 by R. A. Bennett, E. S. Follwell (this problem, giving Black only one piece capable of moving, circumscribes an otherwise pretty position), W. H. Evans, Dicky Sam, Rev. W. Anderson (Old Romney), F. Kenney, J. G. E (Sittingbourne).

F. Kenney.—Your first solution of 872 will not do; as after 1. $\frac{}{\text{B-Q sq (ch)}}$ 2. $\frac{\text{R-B 7}}{\text{Kt-Kt 5 (ch)}}$.

J. G. E.—We have entered you on new Game Tourney. Two games will have to be played simultaneously, and each player has to play one game with every other. Return move must be sent within two days after move received, except under special circumstances allowed by conductor of Tourney. Entrance fee 5s. to constitute a prize fund. Six more entries are needed before the play can begin. Please send name and address.

Game received with thanks from W. Nash.

We shall be glad to have some original problems in two or three moves from our contributors.

"E. M." Tourney Game between G. H. Mainwaring (*White*) and J. Russell (*Black*):—

(Boden's attack.)

1. P-K 4, P-K 4 / 2. Kt-K B 3, Kt-K B 3 / 3. B-B 4, Kt takes P / 4. Kt-B 3 (*a*), Kt takes Kt / 5. Q P takes Kt, P-K B 3 (*b*) / 6. Castles, Q-K 2 / 7. Kt-Q 4 (*c*), Q-B 4 / 8. Q-K 2, P-Q 4 / 9. B-Kt 3 (*d*), B-K 2 / 10. Kt B 3, B-Kt 5 (*e*) / 11. B-K 3, Q-R 4 (*f*) / 12. Q-Q 2 (*g*), B takes Kt / 13. P takes B, P-B 3 (*h*) / 14. K-R sq, Kt-Q 2 / 15. R-K Kt sq, P-K Kt 4 / 16. P-Q R 3 (*i*), Castles (Q) / 17. B-R 2, P-Q 5 (*k*) / 18. P takes P, Q takes Q / 19. B takes Q, P takes P / 20. P-K B 4, P-K R 3 (*l*) / 21. B-K 6, K-B 2 / 22. P-Kt 4, Kt-B sq / 23. B-B 5, K R-Kt sq / 24. Q R-K sq, R-Kt 2 / 25. R-K 4, R-Q 4 / 26. B-R 3, Kt-Kt 3 (*m*) / 27. K R-K sq, P takes P / 28. B takes P (ch), Kt takes B / 29. R takes Kt, P-Q 6 / 30. P takes P, R takes P / 31. R-Kt 4, R takes R / 32. B takes R, B-Q 3 (*n*) / 33. R-K 6, R takes P / 34. R takes P, P-Kt 4 / 35. P-B 4, R-Q Kt 6 / 36. R-B 7 (ch), K-Kt 3 / 37. R-B 6, B takes Kt P / 38. B-K 6, R-Kt 7 / 39. P-B 5, P-Q R 4 / 40. R takes P, P-R 5 / 41. R-Kt 6, P-R 6 / 42. R-Kt 2, R-Kt 8 (ch) / 43. R-Kt sq, R takes R / 44. K takes R, P-B 4 / 45. B-R 2, P-B 5 (*o*), and wins.

Notes.

(*a*) The attack is risky. P-Q 3 safer. The first player, if carefully opposed, should not recover the gambit pawn.

(*b*) P-Q B 3, probably better.

(*c*) Bad; lost time. Kt-K 4 the proper move, or R-K sq.

(*d*) B-Q 3 worth attention; the only way, it seems, of continuing the attack.

(*e*) Black now assumes the offensive, and retains it.

(*f*) If $\frac{}{\text{Q-Q 3}}$ 12. Q R-Q; and if 12. $\frac{}{\text{P-K 5}}$ 13. Q Kt 5 (ch), &c.

(*g*) Wrong to do this before Black has castled on K side. Of course, he now castles Q side, and has a strong attack. P-K R 3, followed by P-K Kt 4 (if B retire to B 4), would have been better.

(*h*) At this point White's front game already looks like a wreck compared with Black's.

(*i*) In view of what is coming, he should have tried to relieve the congestion by Q-K 2, then B-Q 2 or P-Q B 4; but it is difficult to find a good move here.

(*k*) Curious that Black should invite a change of Qs. Another line of play would be P-K R 3, with the intention of pushing forward K B P.

(*l*) Good.

(*m*) Very well played.

(*n*) The upshot is three P's on Q side become passed, which, of course, means a won game.

(*o*) An interesting finish.

ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

A NEW VOLUME.

The next number will be the last of Vol. XXXVIII. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXVIII. will be published on March 21, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 20, and unacknowledged elsewhere:—

A. S. [illegible].—J. Joselyne.—St. George Gore.—Charles Hill.—Archibald and Peck.—Rev. F. Carre.—Forster and Williams.—J. B. Spicer.—Major Allen.—T. W. [illegible].—F. Shaw.—Organ Repairer.—W. M.—Engineer. [illegible].—Dunedin.—J. H.—Fish.—Orderic Vital.—Young Violinist.—Father.—Ancienne.—J. P., Stafford.—[illegible].—M. L. K.—A Spinner.—Homo.—F. Hughes.

OILSHEET. (It is generally known as varnish for oilsheets; though as it does contain a small portion of caoutchouc, it may be distinguished as rubber varnish. Take a quarter-pound of indiarubber in small pieces (preferably the light-coloured portions from the inside of lumps of pure rubber), and soften to a pasty consistency in half a pound of oil of turpentine. Put that into 5lb. of boiled oil, and heat steadily over a slow fire until it is completely dissolved. Then add 6lb. of boiled oil and a pound of litharge. Heat until an even liquid is obtained. It is generally applied warm, by brushes or by drawing the fabric over it.)—JOBBER. (You do not state the nature of the articles to be gilt. You will find recipes for gilding solutions on p. 19, Vol. XXXV., and in many other pages in back volumes.)—H. A. P. (Hurst and Blackett published Miss Meteyard's "Life of Wedgwood." We do not remember the other work.)—AUCTIONEER. (Use glair—white of egg beaten up to a froth and strained—or thin glue to which a little vinegar or nitric acid has been added.)—SPERO. (It is animal jelly, obtained from the organic tissues of the bones, tendons, and ligaments, skin, &c. Glue is a coarser kind, just as isinglass is the purest.)—MOONGAZER. (Impossible to say, except earthshine.)—J. GRIFFITHS. (What information is wanted? They are woven.)—AN ENGRAVER. (You will find one on p. 286, Vol. XV., and another—the best—in Vol. XIII. p. 349.)—PHONO STENOGRAPHER. (We send a number containing a good method; but much depends on the kind of steel. 2. No one could give any useful advice without examining the eye, and you would be unwise to do anything except under competent medical direction.)—ARIEL. (It would no doubt be possible, but the wind is very uncertain. Several forms of windmill were illustrated in some of the back volumes.)—WILLIAMS. (Put some neat's-foot oil into a glass bottle with some clean lead shavings, and hang in the sunshine; the longer the better.)—A. N. Z., Blackburn. (The book you want was advertised on p. xi. last week.)—GIANT'S CAUSEWAY. (The lectures are published in book form by G. Bell and Sons, York street, Covent-garden.)—AMATEUR PIANO-TUNER. (You would learn more from the replies given in recent back volumes than from any book. There is a little book published by [illegible], 170, Strand, W.C.)—W. G. S. (We do not know, but expect it is sold by dealers in dyestuffs.)—[illegible]. (We really do not know, and as a matter of fact, we believe it is nearly insoluble in alcohol.)—H. H. (5-24ths of an ounce. It is very simple. "[illegible]-carat gold" means that there are 8 parts of gold to 16 parts of alloy—i.e., generally 12 parts copper, 4 parts silver.)—J. K. O'C. (We cannot afford space for lists of books on any subject. Watt's "Electro-Metallurgy," published by Lockwood and Co., is one of the most useful. 2. It is a mixture of lime-water and almond oil.)—E. [illegible]. (Your friend has been "solemnly" poking fun at you.)—SOLAR TIME. (The sixcentric barometer was described in Vol. XXXII. p. [illegible]. We do not understand how its indications are to be read at that distance, except by means of a telescope or an electrical indicator. 2. The subject was practically exhausted not very long ago; but we certainly could not give "working drawings to scale" and full details. Any point of difficulty is a subject for a query.)—K. G. I. (You will find some processes described in Crookes's manual of "Dyeing and Calico Printing"; also much information in back volumes. Most of the processes are patented or kept secret.)—JAS. A. [illegible]. (On the whole, we agree with our correspondent "F. R. A. S.," but we have no room for a discussion on the subject, which has long ago been [illegible] in these pages. "Perfect systems" of orthography and caligraphy and calculation somehow lose their charm as one grows older.)—C. L. TWEEDALE. (We think you must find out the first for yourself; we can spare no more space. The *Monthly Notices* are published by the Society. Information as to membership &c., of the Liverpool Astronomical Society should be sought from the secretary.)—LAUNDRY PROPRIETOR. (We should sue them in the County Court at once for the amount due.)—E. G. TURNEY. (We cannot insert queries asking about prices of passage, or how readers may obtain assisted passages or situations aboard ship.)—AMATEUR ARTIST. (We know nothing about the society, and should recommend you to keep your money in your pocket.)—W. MARTIN. (What is the "squabble on the patent law"? A patent will be cheaper now, and afford you better protection.)—INVESTOR. (If a building society can get its money out, and the managers keep honest, nothing can pay a small investor better. We cannot recommend particular societies, and all information as to payment for shares by instalments must be sought from their respective secretaries.)—IGNORAMUS. (No: tradesmen are especially appointed as such.)—ATHLETE. (This is not a sporting paper.)—GEO. GENNINGS. (Do you seriously think we can find space to discuss the maunderings of mystics? Some of the statements you quote are perfectly true—i.e., they are accepted by astronomers; but the author's deductions—well, they are about as true as Jack and the Beanstalk; that *may* be true, you know, for all we can *prove to the contrary*; but we don't discuss it seriously.)—R. M. L. J. (You mean the audiphone—a bit of thin wood or cardboard about 8in. by 6in. slightly bent, and held by the teeth.)—L. W. WILLIS. (See p. 330, Vol. XXIX.; an illustration of the quadruplex arrangement on p. 552, Vol. XXI.)—J. F. PINK. (Not suited to the work. See recent replies.)—W. G. (See replies in recent numbers. The best battery free from fumes is one of the bichromate forms. You will have to arrange the cells in series; the lamps you can please yourself about.)—POTENTIAL. (Will not the articles in Vol. XXXVI., and the many notes on the subject in our volumes suit you? All that can be given without practical tests will be found in any textbook of the science.)—RENNES. (See recent back numbers. The query has been answered frequently.)—MECHANIC. (The Whitworth Papers are published by E. and F. N. Spon, Charing cross, W.C., and T. J. Day, Manchester; but they can be had of any bookseller. We think the price is a shilling.)—ONWARD. (You will find answers to your questions in the back volumes; but there is no hand machine to produce such a light as you require. If you are not satisfied with lamps, try the oxyhydrogen light.)—JOHN STARK. (The only address we know is that you mention of the firm who fit the launches. A letter addressed to care of them would no doubt reach him. The only reference we have had was a news par. at the time, and we have not seen any description of the motor.)—AMATEUR. (One recipe on p. 200, last volume. It is made of equal parts lead plaster, beeswax, olive oil, and yellow resin, with enough whiting to make a paste.)—PHYLLIS. (Directions for making on pp. 227, 296, last volume. You do not say how you coupled the cells. Should be zinc of one to carbon of next.)—T. L. (The question has been frequently answered. If the marks are on the polish they can be easily removed by rubbing with a bit of rag and water; if they are through the polish into the wood, it is clear the part must be repolished after removing the stain with oxalic acid.)—YOUNG AMATEUR ELECTRICIAN. (Gower's telephone, p. 244, Vol. XXIX.; the new one p. 510, Vol. XXXII.)—A SCOT. (There are several in back volumes; but they are makeshift devices. See the appliances to be found in the tool lists—such as that issued by Churchill and Co., Cross-street, Finsbury.)—A YOUNG ENQUIRER. (They are very old. You will find a good deal about them in back vols., and especially on p. 442, No. 389, or p. 333, No. 376.)—THE EAST NEUK OF FIFE. (See p. 515, last week, and the indices generally. Most cyclopædias contain the required information.)—J. R. JACK. (Make whichever you like; but as the modern ones are little more trouble and vastly better when made, you will do well to follow the directions given in recent volumes.)—THETON. (The physician no doubt understands what he is about. By using spectacles now, it is probable the patient will not require them when he is twenty-one. It is difficult to assign the cause, except that the eyeball is too long from back to front, and without spectacles the "disease," as you call it, would become worse.)—DUX SPERO SPIRO. (What about the patentee? That settled, you will find directions in almost any volume since XXIX. You will find a receiver illustrated in the number for June 29 last.)—C. L. TWEEDALE. (Methods of silvering glass have been given many times. See p. 22, Vol. XXXIV., No. 862, and the index of that volume.)—W. ANDERSON. (It proceeds from the stomach or the teeth. No one can do more than guess without examining you. If there are no hollow teeth, clean with areca-nut charcoal, and if the breath is still offensive, you will know the cause is in the stomach, or in some organ which should not be attacked by medicines except under the advice of an expert. Charcoal biscuits are, however, harmless, and may do good.)—W. BENNETTS. (1. The Cantor lectures on that subject at the Society of Arts, published by G. Bell and Sons, York-street, Covent-garden. 2. We do not know.)—DESERT DOOR. (Not yet. Messrs. Spons, Charing-cross, will tell you when and the price.)—NEMO. (H. Amati lived about 1600, but his son Anthony, and grandson Nicholas were also distinguished makers at Cremona.)—[illegible]. (The first two questions frequently answered. The third is answered by referring to the nature of the paper, which is easier separated in the plane of the fibres than across.)—[illegible]. (The question has been answered at length recently. See pp. 117, 120, 142, 331, Vol. XXXVI., and the index to last volume. Part of the question should be put to those who deal in such things.)—CAIRO. (Something like "Gerter.")—CHRIS. (Try frequent washing, with a little borax in the water; daily brushing, and leave nature to do the rest. There is no cure.)—J. H. WARD. (The illustration and description on p. 5[illegible]1 should be sufficient to give you an idea, but if you refer to p. [illegible], Vol. XXXVII., you will find "Signal" writing. "For such a purpose nothing is required but a clock having a wheel turning once a minute, with a point on it touching a spring to close the circuit. The local clocks may be merely a train driving the hands, with an electro-magnet and catch to move the first wheel [illegible] a minute, or oftener if desired.")—A SUFFERER. ([illegible] consult a medical man.)—A TEN YEARS' [illegible]. (Full and explicit directions for making a [illegible] were given in Vol. XXVII. p. 157—not six [illegible].)—H. KING. (It depends on the motor; but [illegible] twice as many as would be needed with bichromate.)—G. FRYER. (Must be due to something in the [illegible] or to the presence of wax. Try the effect of [illegible]. 2. You can silver it by rubbing on the paste [illegible] chloride of silver and cream of tartar, or you could [illegible] it plated cheaply by the bath process.)—[illegible]. ([illegible] mean its commercial preparation, and the [illegible] would be better put to a professional chemist. [illegible] large scale it is prepared by fusing crude [illegible] with double the quantity of powdered native [illegible] phate, washing out the baric chloride rapidly [illegible] water and crystallising.)—W. D. L. (Any [illegible] cotton that will lie close will do. It is not [illegible] anything until made up. 2. With the fine [illegible] and oil. 3. Better see the lists of some of the [illegible]. The sort depends largely on the position [illegible]. 4. By weaving and felting the prepared [illegible].)—THURGOOD. (Two articles, giving complete [illegible] in French polishing, will be found in the [illegible] Oct. 29 and Nov. 12, 1880. Both can be [illegible] publisher for ten halfpenny stamps.)—[illegible] only method of "cold soldering" is that [illegible] p. 81, Vol. XXXV.)—WM. [illegible]. (We [illegible] they are unreliable; we have had similar [illegible] before. Let us know later if you get your [illegible] they shall not advertise again.)—P. G. [illegible] chance was, of course, less than the others. [illegible] something else to do than to work out the [illegible] holders of lottery tickets at fancy bazaars.)—[illegible] (A week's notice.)—J. T. A. (Write the [illegible] the Institution of Civil Engineers, [illegible] College, or the City of London College, [illegible] secretaries.)—C. L. TWEEDALE. (See index [illegible] little consideration for our correspondents' [illegible] space.)—COUNTRY. (No. The child, [illegible] been made "weak and sickly" by [illegible] be the real or supposed evils attendant on [illegible]

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, [illegible] each, through any bookseller or newsagent, or [illegible] each post-free from the office, except index numbers, which are 3d. each, post-free 3½d.

Indexes for Vols. I., VI., VII., VIII., and IX., 3d. each, post free 3½d. each. Indexes to Vol. XI. and to subsequent vols., 2d. each, or post free, 2½d. Cases for binding, 1s. 6d. each.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a coloured Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the Subscription.

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Holloway's Ointment, aided by the Pills. [illegible] thoroughly purified by these Pills, and [illegible] on the surface are effectually [illegible] without pain or danger.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 29, 1884.

HE CENTRAL INSTITUTION OF THE CITY AND GUILDS INSTITUTE.

THE scheme for the organisation of the Central Institution of the City and uilds of London Institute, which has been commended by the Executive Committee the Council for adoption, is a document ssessing much interest for all interested the work of technical education. The ject of the Central Institution is to pro- de for London a college in which advanced struction in those branches of knowledge hich bear upon manufactures and arts will given to students who can afford to pay e fees, or who may be fortunate enough obtain "exhibitions" covering the whole part of their educational expenses. The heme has "South Kensington" written oadly over its face; and it is a matter for gret that the Guilds of London, now that ey are apparently cognisant of the fact t they have long neglected their duties, not keep the whole control of the City Guilds Institute within their own ds. The object of the Central Institution, ording to the "scheme," is to train tech- al teachers, proprietors and managers of mical manufactories and of other in- trial works, as well as mechanical, civil, electrical engineers, architects, builders, persons engaged in art industries; for ch purpose the Institution will consist five chief divisions—viz., 1, Chemical hnology; 2, Engineering—mechanical, l, and electrical; 3, General manu- tures; 4, Architecture and Building Con- ction; 5, Applied Art. But inasmuch the Royal School of Mines is already blished as a training school for mining gineers, no provision will be made for instruction of students in that branch industry; and consequently, geology, eralogy, and metallurgy will not be luded in the list of subjects of truction — for the present at least. first sight it might appear that this Cen- l Institution, which is located in the Ex- ition-road, would cover the field, or a rtion of it, already occupied by the Science d Art Department; but that would be a stake, because the "main purpose of the truction to be given will be to point out application of different branches of ence to various manufacturing industries; d in this respect the teaching will differ m that given in the universities and in her institutions in which science is taught ther for its own sake than with the view its industrial application." The distinc- n is clear and obvious: at the institution se by, students will still continue to be ught science for its own sake; but at the w establishment, science will be taught pressly with reference to its application various branches of our manufacturing dustries, and for this purpose a separate aff of professors, demonstrators, and labo- tory assistants will be required; for, in ldition to lecture theatres and classrooms, e Central Institution will be fitted with boratories, drawing offices, and work- ops; and opportunities will be afforded r the prosecution of original research with e object of the more thorough training of e students, and for the elucidation of the eory of industrial processes. It will be en that the technical education of the working man," who was the object of the ovement primarily, is left entirely out of e scheme, except in so far as he may be cluded under the head of "technical achers." These latter will consist of students entering the Institution from the Finsbury Technical College, or other similar colleges in the provinces, by means of exhibitions; of students selected at the May examinations in technology who pass with special distinction in the Honours grade; and of registered teachers of the Institute, who, during certain months of the year, will receive gratuitous instruction, and have the use of the laboratories, &c. The students proper will consist of persons not under sixteen years of age, who, having passed a matriculation or entrance examination, are prepared to take a complete course of instruction with a view to some professional or industrial occupation. These students will consist of those who pay full fees and of those who enter by means of "exhibitions." The third class of students will consist of those who, already engaged in industrial pursuits, may desire to attend special courses with the view of learning the scientific principles underlying the manufactures or arts with which they are connected. The matriculation examination for students who enter with the view of obtaining a diploma will include mathematics pure and applied, chemistry, physics, drawing, and modern languages; and the fee for the courses will be about £30 per annum, while a fee of about £20 per annum will be charged to those students who wish to take special courses and occupy the greater part of the day in laboratory practice and research work. To encourage the latter, advanced students, and non-matriculated students (under very special circumstances), will be provided with separate laboratories, in which to work free from distraction or disturbance. It is clear from the above that not only is the technical education of the working man quite beneath the scope of the Central Institution, but that the working classes are practically excluded, unless some few of them are fortunate enough to gain exhibitions of sufficient value to provide for their support in London during the two or three years over which the course of instruction will extend. To provide for the teaching of the students it is proposed to elect forthwith four professors — those respectively of chemistry, mechanics and mathematics, engineering, and physics—at salaries of £1,000 per annum each, with a prospect of increase, depending upon the number of students in attendance; leaving the professorships of architecture and building and of applied art vacant until the organisation of the Institute has been established. The salaries of the four professors represent a considerable portion of the funds that will be needed; but to provide the requisite instruction in the department of chemistry it will be necessary to have one chief professor, who will devote the whole of his time to the Institution, and two assistant professors, each taking charge of one of the three large laboratories which have been provided. Besides these professors, demonstrators, laboratory and lecture assistants, and attendants will be required—a remark which applies to all the departments; but in those of engineering and physics the election of an additional professor is contemplated at an early date. Besides what may be termed the professorial staff—the planets and their satellites—there will be a number of lecturers, who may or may not be on the permanent establishment, and who will lecture during the session to the matriculated students, and during the recess to teachers of technical classes in London and the provinces, who will be invited to attend without payment of fee, while it is expected that arrangements will be made by which other persons seeking information on technical matters may be admitted to these lectures. Systematic courses of instruction will be drawn up for matriculated students, which will be obligatory on those desirous of gaining the diploma of the Institute. That will consist primarily of the Associateship, to be granted to students of three years' standing who have passed all the examinations; and secondly, the Fellowship, to be conferred upon those who, having obtained the Associateship and spent at least five years in actual practice, can produce evidence of having done some original and valuable research work, or of having otherwise advanced the industry in which they are engaged. In one paragraph of this "scheme" we are told that should the scheme now proposed be adopted, there are numerous details connected with it which will "need to be carefully worked out"; but it is recommended that the four professors should at once be appointed, because we suppose they are to form the Board of Studies, and it will be necessary to get everything ready before the students arrive, and to select the subordinates of the professorial staff. Any lecturer holding an annual appointment may be elected by sub-committee A a member of this Board; but the organising director and secretary of the Institute, although he may be present and take part in the discussions of the Board, is not to be entitled to a vote, which seems a rather peculiar arrangement seeing that a lecturer may have a vote, especially when it is remembered that this Board will practically have the power of appointing and removing instructors, teachers, demonstrators, and attendants, though nominally "recommending" the Institute. The exact meaning of appointing lecturers to the Board may be understood from the fact that, although at the outset the education of day students is all that will be attempted, it is desirable that evening instruction should be given at the Central Institution, consisting of courses of lectures dealing with some of the applications of science or art to special branches of industry. The Board of Studies will it seems not have the power of selecting and dismissing lecturers, nor even of recommending the Institute to do so; but should a sufficient number be appointed to the Board, they will practically control the vote. The Guilds of the City of London have still the power to control the action of whatever governing body may be appointed to determine the course of procedure in connection with their Central Institution, because they are the chief subscribers of the funds, and by withholding them they can practically throw the casting vote. It is to be hoped that they will give an early indication of their intention to do so, for judging by previous experience, it is easy to foresee that if the scheme as proposed is adopted, the outcome of the agitation for technical education will end in the establishment of a permanent staff of well-paid professors, lecturers, and assistants, whose labours will be devoted to the instruction, not of the workmen of the country, but of those who in London are already well provided for at University and King's Colleges.

THE SPEEDWELL SHOW.

THE annual exhibition of bicycles and tricycles known as the Speedwell Show, was held last week in Bingley Hall, Birmingham, the formal opening being preceded by a speech, in which Mr. Jaffray gave some interesting statistics of the trade. It appears that the average make of bicycles and tricyles now ranges from 500 to 600 per week—the output for last year being estimated at 30,000, while more than 10,000 tricycles were sold last year in the United Kingdom alone. The capital employed is about half a million sterling, and altogether some 10,000 hands are directly engaged in the trade. The exhibition, which contained over 500 machines, is the third held by the Speedwell Bicycle Club, and was extensively patronised by the general public—probably, to a certain extent, because they know that part of the profits made by the Club is distributed amongst the charities of the town. Most of the firms who exhibited at the Stanley Show also put in an appearance at the Speedwell, but there is nothing very novel in the exhibits. Most of the makers who exhibit tricycles dwell on the hill-climbing capabilities of their machines, or on the "speed and power gearing" with which they are fitted; but *the* novelty was the convertible boat tricycle of Captain Terry, in which he journeyed from Paris to London last summer. The boat portion consists of a light metal framework 12ft. long, 3ft. 8in. broad, and 2ft. deep, which is covered with waterproof canvas when it is desired to travel on the water. A steam tricycle is also shown. Ellis and Co., of Fleet-street, exhibited their Facile bicycles, which are rapidly coming into favour amongst those who want a safe machine, but have not room to stable a tricycle. Messrs. Devey and Son, of Wolverhampton, had on view their cheap bicycle known as the Working Man's Friend, the price of which, compared with others, is remarkable; and Mr. T. Clarke, of Manchester, had also some notably cheap bicycles, while Mr. Burdess, of Coventry, staged some of his "Sterling" machines. Mr. Brown had his usual assortment of parts, and also exhibited the new steering gear, in which the wheel is turned by a couple of bands of phosphor bronze winding on a drum. One excellent feature of the Speedwell Show is that the "exhibition" is confined to the body of the hall, the galleries being available for the trial of machines by intending purchasers.

ASTRONOMICAL NOTES FOR MARCH, 1884.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination.	Sidereal Time.
	h. m. s. p.m.	h. m. s.	° ′ ″	h. m. s.
1	0 12 24·81 ,,	22 51 12	7 18 39 S.	22 38 46·74
6	0 11 18·04 ,,	23 9 48	5 23 9 ,,	22 58 29·50
11	0 10 0·85 ,,	23 28 13	3 25 54 ,,	23 18 12·26
16	0 8 36·06 ,,	23 46 31	1 27 39 ,,	23 37 55·02
21	0 7 6·64 ,,	0 4 45	0 30 52 N.	23 57 37·77
26	0 5 35·14 ,,	0 22 56	2 28 53 ,,	0 17 20·53
31	0 4 3·80 ,,	0 41 7	4 25 37 ,,	0 37 3·29

The Method of finding Local Sidereal Time at Mean Noon at any given station will be found on p. 358.

At 5 a.m. on March 20th the Sun is said (technically) to enter Aries, and Spring is supposed to commence. At the instant referred to, he is, in reality, some 6° south-by-east of ω Piscium.

Solar activity continues to manifest itself with but slight diminution, and spots and faculæ of considerable size and beauty appear on the Sun's disc.

The Zodiacal Light may now be seen in the west, above the spot where the Sun has set, presenting the appearance of a luminous blunted cone, with its axis lying roughly in the plane of the Ecliptic.

A Partial Eclipse of the Sun, visible only in high North latitudes, will occur during the early morning of March 27th: but it needs no further mention here.

The Moon

Enters her First Quarter at 1h. 33·1m. in the afternoon of March the 4th, and is Full at [illegible] p.m. on the 11th. She will enter her Last Quarter at [illegible] on the night of the [illegible], and be New at [illegible] a.m. on the 27th. [illegible] high tides may be expected about the [illegible].

Day of Month.	Moon's Age at Noon.	Souths.
	Days	h. m.
1	[illegible]	2 24·[illegible] p.m.
6	[illegible]	[illegible] ,,
11	[illegible]	[illegible] ,,
16	[illegible]	[illegible] a.m.
21	[illegible]	[illegible] ,,
26	[illegible]	[illegible] ,,
31	[illegible]	[illegible] p.m.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex	Reappearance.	Moon's Limb.	Angle from N. Point.
			h. m.		°	°	h. m.		°
3	δ^1 Tauri	4	10 44 p.m.	Dark	115	156	11 35 p.m.	Bright	247
3	δ^2 Tauri	6	11 10 ,,	Dark	93	134	12 5 ,,	Bright	267
4	115 Tauri	6	12 51 ,,	Dark	46	85	1 31 a.m.	Bright	307
6	λ Geminorum	3½	10 10 ,,	Dark	107	134	11 11 p.m.	Bright	226
8	κ Cancri	5	10 18 ,,	Dark	47	53	11 29 ,,	Bright	271
10	16 Sextantis	6	4 7 a.m.	Dark	100	139	4 56 a.m.	Bright	221
10	34 Sextantis	6	6 13 p.m.	Dark	44	5	7 8 p.m.	Bright	277
11	υ Leonis	4½	9 22 ,,	Bright	98	70	10 25 ,,	Dark*	215
24	σ^3 Capricorni	6	†4 27 a.m.	N. by W.	194	157			

* But apparently bright. † A near approach.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Ec R	3	55	25 A.M.
1	I	Tr I	10	2	P.M.
1	I	Sh I	10	58	,,
1	I	Tr E	12	22	,,
2	I	Sh E	1	18	A.M.
2	I	Oc D	7	10	P.M.
2	III	Ec R	7	51	54,,
2	I	Ec R	10	24	14,,
3	I	Tr E	6	49	,,
3	I	Sh E	7	47	,,
4	IV	Ec D	9	48	41,,
5	II	Tr I	1	32	A.M.
5	IV	Ec R	2	15	42,,
5	II	Sh I	3	29	,,
5	*II*	*Tr E*	4	27	,,
6	III	Tr I	2	24	,,
6	II	Oc D	8	36	P.M.
7	II	Ec R	1	27	27 A.M.
8	I	Oc D	2	32	,,
8	II	Sh E	7	42	P.M.
8	I	Tr I	11	51	,,
8	I	Sh I	12	53	,,
9	I	Tr E	2	11	A.M.
9	I	Sh E	3	13	,,
9	III	Oc R	7	41	P.M.
9	III	Ec D	8	23	44,,
9	I	Oc D	8	59	,,
9	III	Ec R	11	52	3,,
9	I	Ec R	12	19	25 P.M.
10	*I*	*Tr I*	6	18	,,
10	I	Sh I	7	22	,,
10	I	Tr E	8	38	,,
10	I	Sh E	9	42	,,
11	I	Ec R	6	48	10,,
12	*II*	*Tr I*	3	57	A.M.
12	IV	Tr I	7	41	P.M.
12	IV	Tr E	12	8	,,
13	II	Oc D	11	0	,,
14	*II*	*Ec R*	4	2	59 A.M.
15	II	Sh I	7	24	P.M.
15	II	Tr E	8	5	,,
15	II	Sh E	10	19	,,
16	I	Tr I	1	41	A.M.
16	I	Sh I	2	48	,,
16	*I*	*Tr E*	4	0	,,
16	III	Oc D	7	47	P.M.
16	I	Oc D	10	49	,,
16	III	Oc R	11	20	,,
16	III	Ec D	12	24	7,,
17	I	Ec R	2	14	41 A.M.
17	*III*	*Ec R*	3	52	52,,
17	I	Tr I	8	8	P.M.
17	I	Sh I	9	17	,,
17	I	Tr E	10	28	,,
17	I	Sh E	11	37	,,
18	I	Ec R	8	43	27,,
21	II	Oc D	[illegible]	[illegible]	
21	IV	Ec R	[illegible]	[illegible]	
22	II	Tr I	[illegible]	[illegible]	
22	II	Sh I	[illegible]	[illegible]	
22	II	Tr E	[illegible]	[illegible]	
22	II	Sh E	[illegible]	[illegible]	
23	*I*	*Tr I*	5	[illegible]	
23	III	Oc D	[illegible]	[illegible]	
23	I	Oc D	[illegible]	[illegible]	
24	*III*	*Oc R*	[illegible]	[illegible]	
24	II	Ec R	[illegible]	[illegible]	
24	I	Tr I	[illegible]	[illegible]	
24	I	Sh I	[illegible]	[illegible]	
24	I	Tr E	[illegible]	[illegible]	
25	I	Sh E	[illegible]	[illegible]	
25	*I*	*Oc D*	[illegible]	[illegible]	
25	I	Ec R	[illegible]	[illegible]	
26	*I*	*Tr E*	6	[illegible]	
26	I	Sh E	[illegible]	[illegible]	
27	III	Sh E	[illegible]	[illegible]	
29	II	Tr I	[illegible]	[illegible]	
29	IV	Sh I	[illegible]	[illegible]	
29	II	Sh I	[illegible]	[illegible]	
30	II	Tr E	[illegible]	[illegible]	
31	*I*	*Oc D*	[illegible]	[illegible]	
31	II	Ec R	[illegible]	[illegible]	
31	I	Tr I	[illegible]	[illegible]	

Ec Eclipse: Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disap R Reappearance: I Ingress; E Egress. The printing of a phenomenon in italic indi its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's pr to the horizon.

The Moon will be in conjunction with Saturn at 7h. p.m. on the 3rd; with Jupiter at 1 o'clock in the afternoon of the 7th; with Mars at 5h. a.m. on the 8th; with Mercury at 2h. a.m. on the 27th: with Venus at 6h. a.m. on the 30th; and, for the second time this month, with Saturn at 5h. a.m. on the 31st.

Mercury

Is a Morning Star up to the time of his disappearance, in superior conjunction with the Sun at 8 a.m. on the 30th, but is very poorly placed for the observer during any part of the month. His diameter decreases from 5·6 on March 1st to 5' by the 14th, at which angle it remains stationary.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	21 29·5	16 39·3	10 50·9 a.m.
6	21 59·6	14 27·4	11 1·3 ,,
11	22 30·9	11 43·6	11 12·8 ,,
16	23 3·0	8 28·3	11 25·2 ,,
21	23 36·4	4 42·8	11 38·8 ,,
26	0 11·0	0 29·7	11 53·7 ,,
31	0 47·2	4 5·0 N.	0 10·1 p.m.

The path indicated by the above Ephemeris begins in the North Eastern part of Capricornus, and extends through Aquarius into Pisces.

Jupiter

Like Mars, may be seen all night long: b the case of all the planets, is most fav placed when within an hour or two meridian. As the distance of the earth fr increases, obviously his diameter will di As a matter of fact, it decreases from the 1st of March to 37·2" on the last day month. He, however, continues to p noble and all-repaying sight to the obser the telescope.

Day of Month.	Right Ascension.	Declination North.	S
	h. m.	° ′	h.
1	7 48·4	21 44·1	9
6	7 47·3	21 46·9	8
11	7 46·6	21 48·9	8
16	7 46·2	21 50·0	8
21	7 46·1	21 50·1	[illegible]
26	7 46·4	21 49·5	[illegible]
31	7 47·0	21 47·9	[illegible]

To the naked eye, Jupiter will not s move from a point in the confines of G almost due west of the 6-5th mag. Star

Venus

Is an Evening Star during the whole of and is a brilliant and conspicuous objec the western horizon long after sunset. S y fair position for the observer, but the disc xhibits in the telescope, although increasing ameter from 14·2″ on the 1st to 17·2″ by the is still gibbous, and hence does not present ticularly interesting spectacle.

	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
	1	11·2	7	36·5	2	32·0	p.m.
	1	33·1	10	6·2	2	34·2	,,
	1	55·1	12	30·2	2	36·5	,,
	2	17·3	14	47·2	2	38·9	,,
	2	39·6	16	55·7	2	41·6	,,
	3	2·3	18	54·5	2	44·5	,,
	3	25·1	21	2·2	2	47·6	,,

arting thus from a point roughly half-way een ε and μ Piscium, at the apex of a very triangle whereof they form the extremities e base, Venus thus travels across the whole h of Aries, and is found by the end of the h in that blank part of the sky near to (and -west of) the Pleiades.

Mars

isible all night long, and although his lar diameter decreases from 14·4″ on March o 11·2″ on the 31st, he is still an interesting ct in a telescope of sufficient power.

Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	8	26·1	23	18·7	9	45·7	p.m.
6	8	23·7	23	15·9	9	23·7	,,
1	8	22·7	23	8·2	9	3·0	,,
6	8	22·9	22	56·1	8	43·6	,,
1	8	24·4	22	40·2	8	25·4	,,
6	8	27·0	22	20·7	8	8·3	,,
1	8	30·6	21	57·8	7	52·2	,,

Hence it will be seen that Mars describes a in the sky to the West, and somewhat to the th of γ Cancri. Up to about the 13th he is velling towards the west, but he then turns nd and pursues a direct path towards the star rred to.

Saturn

s between 1 and 2 a.m. at the beginning of rch, and before half-past 11 at night at the of it. Hence he will be best observed as n after dusk as possible. No perceptible nge in the opening of his ring system will ur, as far as the ordinary observer is concerned, nor will the diminution in his angular meter from 16·4″ to 15·6″ during the month be more noticeable. Our ephemeris of Saturn l be discontinued after this month until his reearance as a Morning Star in September.

Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	4	8·8	19	17·8	5	29·2	p.m.
6	4	9·9	19	22·0	5	10·6	,,
1	4	11·2	19	26·5	4	52·2	,,
6	4	12·6	19	31·4	4	34·0	,,
1	4	14·2	19	36·6	4	15·9	,,
6	4	15·9	19	42·1	3	57·9	,,
1	4	17·8	19	47·9	3	40·2	,,

rom which Ephemeris it will be seen that urn is travelling towards (although a little ve) the 4—3rd magnitude Star ε Tauri, which s the right hand top of the "V" of the ades.

Neptune

ths in bright daylight, and is too near the t to be fairly observed. We shall resume Ephemeris of him when he becomes a Morn- Star in October.

Uranus

in the sense of his time of southing, a Morn- Star at the very beginning of March, but es into opposition to the Sun at 6 a.m. on the h; souths for some days prior to this soon r midnight, and before the end of the month sses the meridian between 10h. and 11m. p.m. reover, he is visible during the whole of the king hours of the night, and his pale blue disc (4″ in diameter) may be picked up readily an hour or two after sunset with a very moderate telescope.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	11	49·4	2	1·1	1	12·4	a.m.
6	11	48·5	2	7·1	12	47·8	p.m.
11	11	47·7	2	12·3	12	27·4	,,
16	11	46·9	2	17·4	12	7·0	,,
21	11	46·1	2	22·6	11	46·5	,,
26	11	45·3	2	27·7	11	26·1	,,
31	11	44·5	2	32·6	11	5·6	,,

Whence it will be seen that Uranus describes a short retrograde arc in the region of the sky between η and β Virginis, towards which last-named star he is travelling.

Shooting Stars

May be looked for from the 1st to the 4th, and again on the 16th.

Greenwich Mean Time of Southing of Thirteen of the Principal Fixed Stars on the Night of March 1st, 1884.

Star.	Souths. h.	m.	s.	
α Leporis	6	47	44·20	p.m.
α Columbæ	6	55	33·01	,,
α Orionis	7	8	57·71	,,
γ Geminorum	7	50	58·20	,,
Sirius	7	59	58·05	,,
Castor	8	47	0·68	,,
Procyon	8	53	1·29	,,
Pollux	8	57	59·95	,,
β Cancri	9	29	55·11	,,
α Hydræ	10	41	23·31	,,
Regulus	11	21	35·10	,,
α Ursæ Majoris	12	15	48·95	,,
δ Crateris	12	32	44·51	,,

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in March, will be found on p. 359, and that of determining the Local Instant of its Transit at any other Station, on p. 360.

GERN'S PNEUMATIC ACTION FOR ORGANS.

SOME improvements in connection with the valve action of organs, and also in the methods of obtaining increased pressure of wind, have been recently patented by Mr. Augustus Gern, of Notting-hill, W., the object of which is to simplify the construction and operation of the parts, to avoid loss of wind, and to prevent the objectionable sounds which often result from leakage. In the illustration, Figs. 1, 2, and 3 show an arrangement for working pneumatically the valve of an organ pipe by the combined action of a finger key and a stop slide. Fig. 1 shows the action of the key, Fig. 2 the action of the stop slide, and Fig. 3 their combined action on the valve. In Fig. 1, A is one of the keys, shown as it would be when depressed by the finger of the performer; this movement raising a stud, *a*, fixed (adjustable in height) on the key, and so opening a valve B and closing a valve C. Both these valves are situated in the key duct D, the valve B governing an outlet for escape of air, and the valve C governing a passage from a channel E, which is charged with air at the same pressure as the air in the windchest. When the key A is released, the valve B closes and C opens, so that the key duct D becomes charged with air from E at the windchest pressure. In Fig. 2, F is a slide worked by the stop pull. It has through it a hole G, which, in the position of the slide as shown, forms an escape passage from the stop duct L. When the slide F is pushed in, the hole G is brought to the dotted position G^1, giving passage to the stop duct L from a channel H, which is charged with air at the windchest pressure. In Fig. 3, D is the key duct and L the stop duct, communicating respectively by passages *d* and *l*, with a cavity M containing two connected valves m^1 m^2, either of which is open when the other is closed. N is a piston, connected to, and somewhat larger in area than the valve O which governs the passage to a pipe.

The piston N works freely in a cylinder P, situated in the windchest above and in communication with the cavity M. A spring *n* supports the weight of the piston and valve. When the stop slide is in the position shown in Fig. 2, the stop duct L being then open to the atmosphere, the valve m^2 (Fig. 3) is closed, m^1 remaining open. If now the key A be depressed, as shown in Fig. 1, opening B, and allowing escape of air from the key duct D, then, the pressure in M being relieved, the piston N is pressed down by the excess of pressure in the wind chest, and the pipe valve O is opened. When the key A is released from the pressure of the finger, allowing B to close and C to open, then air from E charges the key duct D and by it the cavity M is charged with wind to the same pressure as that in the windchest. The piston N being thus subjected to as much pressure below it as there is above it, rises, closing the valve O. When the stop slide F (Fig. 2) is moved so as to close the escape from L and to open the passage from H to L, then the pressure in the stop duct L being thus made equal to that in the windchest there is no force tending to close the valve m^2 or to keep it closed. If now, the key A (Fig. 1) be depressed, reducing the pressure in the key duct D, the valve m^1 will close, and as the pressure in M is unaltered, there is no movement of the piston N, and consequently no opening of the pipe valve O. Thus, according as the stop slide F is in the one position or the other, allowing escape from the stop duct L or keeping it charged, the depression of the key A is effective or ineffective in opening the pipe valve O. It is to be understood that there are side by side, a number of ducts D, one for each key of the manual, each of these ducts having a series of passages *d*, one for each range of pipes constituting a stop; also, that for each stop of pipes there is a stop duct L, each of these stop ducts having a series of passages *l*, one to the cavity M for each pipe of the stop. Thus, one key, such as A, governs the valves of all the A pipes of a number of different stops, and one slide F governs the valves of all the pipes in one stop, but no pipe of any stop can be sounded unless that stop is brought into action by putting its slide F in the position shown in Fig. 2, and unless the key A is also depressed. Sometimes, for the purpose of effecting combinations of stops, it is desirable that each pipe valve should be governed by two or more stop slides, and, sometimes, for the purpose of coupling manuals, it is desirable that each pipe valve should be governed by two or more keys. In such cases, the cavity M may have several sets of valves, such as m^1 m^2 arranged in it. Fig. 4 is a section showing the invention for intensifying the wind pressure of an organ or wind instrument of like kind, that is for obtaining a supply of air of greater pressure than that of the air delivered by the bellows. A is a box containing a collapsible vessel B, constructed as a bellows, which, at the bottom, communicates with a channel C provided with a valve *c* opening towards B, and also with a channel D provided with a valve *d* that opens from B. The channel C is supplied with air from the bellows or windchest of the instrument; the channel D is for conducting air at a higher pressure to some part of the instrument where higher pressure is required. The box A has two openings, one to the outer air governed by a valve E, and one to the channel C governed by a valve F. The valves E and F are jointed to opposite ends of a lever G, so that the one is open when the other is closed. On the fulcrum of the lever is pivoted a heavy plate H, which acts as a tumbling weight, and has on its side two studs h^1 h^2 projecting so as to come in the way of the lever G. There is also in H an elongated hole, into which a stud, *b* projects from the middle partition of the bellows B. The top of the bellows B is loaded to the extent required to give the desired increase of pressure, the load however being such as can be raised by the pressure of the air in C. The action of the apparatus is as follows. The valve *d* being closed by the superior pressure in D, and the valve E being open and F closed, air from C passes the valve *c* and inflates B, the air thus displaced in the box A escaping by the open valve E. When the inflation of B is nearly completed, the stud *b* meeting the upper part of the hole in H, moves H until its centre of gravity passes the vertical line through its pivot, whereupon the weight of H causes it to tumble over to the position shown in Fig. 4, and its stud h^1 moves the lever G so as to close the valve E and to open F. The box A being now charged with air having the pressure of the air in C, the bellows B collapses,

Fig. 2

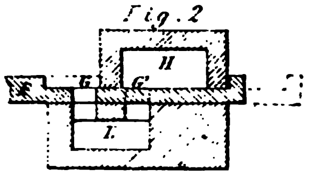


Fig. 4

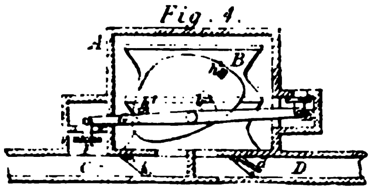


Fig. 1.

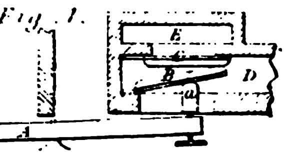
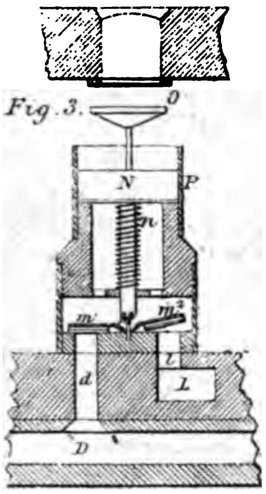


Fig. 3.



discharging its contents past the valve *d* into D at a pressure greater than that in C by the amount due to the load on B. As the stud *b* approaches the lower extremity of its stroke, it meets the lower part of the hole in H and causes H to tumble over to the right hand, the stud h^2 moving the lever G so as to close F and to open E, whereupon the action is repeated. The channel D may lead to a pressure regulator, and there may be several sets of the apparatus shown in Fig. 4, acting in successive order to deliver wind of intensified pressure into the wind chest or regulator. When still greater increase of wind pressure is required, the channel D conducts the air to a second intensifying apparatus of the kind described, and there may be a series of these, each adding to the pressure of the wind an amount due to the loading of its bellows B.

THE DYNAMO: HOW MADE AND HOW USED.—XIV.*

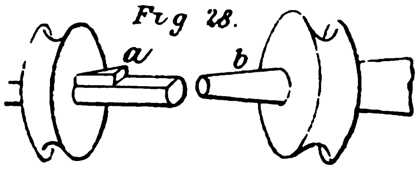
By SELIMO R. BOTTONE.

§ 29. IN order to communicate the motion from the flywheel to the armature, a small pulley wheel, either of iron or brass, is fitted to the back trunnion, just outside the bearing. Such a pulley wheel may be bought at any ironmonger's, and should be about 1¼in. in diameter, and rather over ¼in. thick, with the central hole somewhat smaller than the diameter of the rod which serves for the armature trunnion. This may be attached to the trunnion in either of the two following ways:—1st. By "keying," which consists in filing the trunnion along its length, in one direction only, so as to produce a flattened side; then having, with a rat's tail file, cleaned out the central hole of the pulley to such an extent that the said trunnion will only just enter, to deepen one side (corresponding to the flattened side of the trunnion) so as to admit of a small steel wedge or "key" being inserted (see Fig. 28*a*). 2ndly. By filing the trunnion rod to a slightly conical shape, and producing a similar "coning" in the interior of the pulley hole, which may then be driven on (see Fig. 28*b*, where the "coning" of the trunnion is exaggerated, to render this mode of attachment more plainly visible). Whichever mode of attachment is adopted, one precaution must be taken—viz., that the distance between the back of the field magnets and the pulley should not be *less* than 1¼in.; otherwise, when the limbs of magnets are wound with wire, the flywheel will run too close to them to be altogether safe.

§ 30. The flywheel which gives motion to the armature, should be a pretty heavy wheel, about 13in. in diameter, with a groove in the rim to take the band which drives the pulley, furnished with a wooden handle, for convenience of rotating. Such wheels may be obtained ready made in cast iron, from most ironmongers, as they are sent out with "rotary blowers," "portable forges," &c. Fig. 29*a* gives an idea of the kind of wheel necessary, on a scale of 1¼in. to the foot. The central hole is turned, and only requires fitting with an iron pin, on which it turns. Since the aperture in these wheels is about ¾in. in diameter, the pin must be filed down to half an inch diameter where it has to fit the hole in the flange at the top of the dynamo.

The farthest end should have a rounded head, to prevent the wheel from working off, while the portion which passes into the eye at the top of the flange must have a thread put on it, so as to take a nut (see Fig. 29*b*).

Fig 28.



§ 31. All the portions of the dynamo being now fitted. they should be marked so to insure putting together again in right order after winding. When this has been done, the limbs of the field magnets, at all parts except the channel for the armature, and the inner face of the semicircular top which rests against the wheel bracket, should receive a coat of good Brunswick black, allowing them to dry between each application, in a warm oven. The bracket should likewise receive a coat or two of the same varnish, except where the semicircular tops clinch it. This portion *must* be left metallic, so as to insure magnetic contact; otherwise much magnetic power is lost. Two strips of silk (colour immaterial) 10in. by 3¼in. wide, should now be quickly brushed with Brunswick black, and wrapped, while sticky, one round the one limb, and the round the other limb of the field magnets space between the armature channel bend at the top. (See Fig. 15, where the tions indicated are marked respectively 3¼".) The object of this silk wrapping sulate the wire thoroughly from the iron, prevent any accidental abrasion of the wire, which may take place during winding from short-circuiting to the iron. When the silk has been laid smoothly tightly on, the limbs may be returned oven, and allowed to dry at a gentle heat precisely the same manner, the interior their central portion of the armature (technically known as the "web") must be varnished Brunswick black, and wrapped with one similarly-prepared silk. Three pieces required to do this effectually—viz., two 3⅝in. long by 1¼in. wide, shaped as in Fig. to fit against the inner faces, and one long, by ¾in. wide, to wrap round the Particular care must be taken that every of the inside of the armature's channel tirely covered in silk. When this has satisfactorily performed, another coat wick black may be given (avoiding outside), and the armature allowed thoroughly in a warm oven.

Fig. 29.

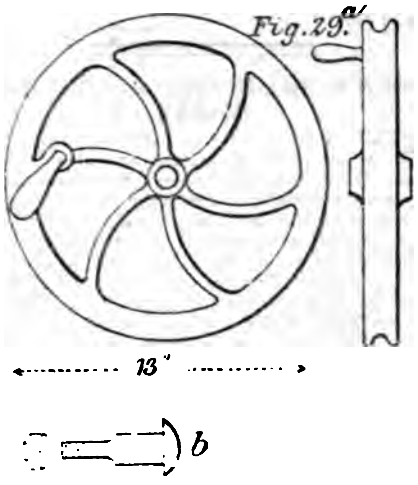
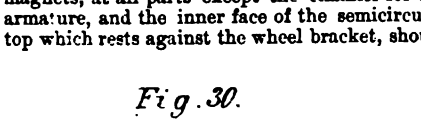


Fig. 30.



§ 32. Our dynamo is now ready For this purpose we shall require No. 16 single cotton-covered copper field magnets, and about ¼lb. No. 20 covered for the armature. The be careful to get *new* wire, of the ductivity, and very soft; the employ kinky, and hard wire is fatal to success.

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* All rights reserved.

MACHINE TOOLS.

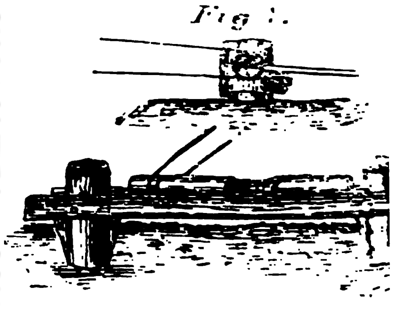
AN ordinary meeting of the Civil and nical Engineers' Society was held inst., the President, Mr. Harkness M.I.C.E., in the chair, when Mr. A.M.I.C.E., read the following paper Tools."

It is quite impossible, in the necessary limits of a paper like this, to give a detailed description of modern is proposed rather to endeavour to early simple types the present cated pieces of automatic mechanism, taking the place of skilled hand labour ally been evolved.

The great principle underlying or automatic tool is the guide principle.

This may be defined in the following Either the cutting tool is mechanically

Fig. 1.



the direction in which it is intended to while the material remains fixed, or the mechanically guided whilst the tool or both the material and the tool are guided in the desired directions at one same time. This latter, it will be seen, is advance. The shaping machine and machine are instances of the first form, the machine of the second, and the self-acting the third, and it is thought we shall find machine, however intricate or automatic, referred to one or more of these forms of principle.

There seems little doubt that the earliest of all machine tools, and what is every machine tool of the present day referred back to and be shown to have gested by the lathe.

It is believed that there is still in use in try districts of India, a form of lathe, than is impossible to suppose anything more The native turner has no fixed carries his lathe and tools about with him.

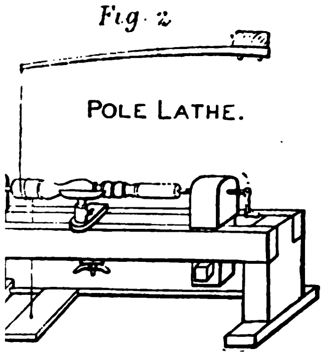
e, that a customer requires a new leg
table. The turner is sent for. His firs
is to dig two holes in the ground. In
astens, by means of wedges, two short,
. Through the top of each post a pointed
is driven, with the point protruding;
ese points, the wood, which is to form
g, is centred. A long strip of wood is
he posts, parallel with the material, to
st for the tools, and the lathe is then
All that is wanted is the motive power.
plied by a boy, who squats on the ground
ne or two turns with a leathern thong
wood, then by holding one end of the
ch hand he imparts a to-and-fro rotary
he material.

er himself squats on the ground, with
inst the rest, and the end of his gouge
usually of the rudest character,
ween his toes, which he uses in prefer-
fingers, and the other end of the tool
y the hands, he rapidly forms the new

this essentially rough and simple con-
presented in Fig. 1, we yet have the
of the guide principle. The tool, it is
endent for its guidance upon the skill of
an; but the material is mechanically
nd rotated in a true circle, so that, how-
lar the finished production may be
lly; yet, if a cross section of it be taken
t will be found to be practically a true

ossible to say how old this primitive
he may be; but up to within recent
as the type of nearly every lathe in

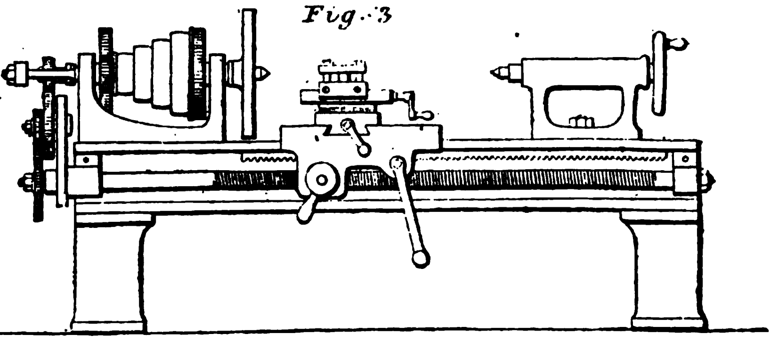
Fig. 2



ugh of course in a far more finished
at this day is in use, not only by the
, as the example of the ordinary watch-
e, or "turns," as they are technically
before you will prove, but by the
rs of common wooden chairs, and of
d-bowls or basins. These old lathes,
ig. 2, generally known as pole lathes,
one headstock, with a spike or centre
upon a bed formed of two parallel
od, such bed being supported by suit-
rds, while another headstock, with a
t, was movable about the bed, and
d at any point by a wedge, to suit the
e material to be turned. Overhead,
end to the beams of the ceiling, was a
y wooden pole or lath, and to the
this lath a cord or leathern thong was
hich, after being passed once or twice
aterial to be operated on, was formed
or the foot at its lower end, or in a more
ttern was attached to a treadle. It is
idered that the name of lathe is derived
overhead spring pole or lath. This
t, of course, gave only a reciprocating
n like the Indian lathe, so that just
the time of the workman was lost; and
had to be slightly retracted at every
e, instead of being kept continuously
on the rest, accuracy of work was
he next step was to use a wheel some-
under the bed of the lathe, and re-
eans of a treadle and crank by the
etimes fixed at a little distance and
a winch by an assistant, or in the case
es, by horse power. A band or cord
round this wheel and the material, a
rotary motion was obtained.

chine was, of course, only capable of
as it was merely able to turn work
ted of support at both ends, therefore,
p was to substitute for the plain fixed
a spindle or mandrel, working in two
th a pulley upon it between them to
and or cord from the driving wheel.
otruding end of this spindle, furnished
rnal or internal screw, material could
arious ways without requiring the sup-
other centre, and in this apparatus we
pe of the ordinary light foot-lathe of
llustrated by some of the photographs

Fig. 3



Having now a true circular motion or guide for the material, the tool, it will be seen, is still at the mercy of the fingers of the workman, and sometimes, if he be clumsy, he finds to his cost that his fingers are at its mercy. Let us now suppose that we rigidly grip the tool in some suitable contrivance, which shall, tool and all, be able to slide along the bed of the lathe, such bed being first made perfectly true and parallel. Then we have not only the material truly and automatically guided in its path of rotary motion, but the tool also guided in a straight line, the result being, truth in the form of the finished material, and what is of equal importance, the capability of reproducing the same form any number of times; both results being independent of any individual skill on the part of the workman.

An obvious advance upon this arrangement is to supply a second sliding guide for the tool at right angles to the first motion or across the bed of the lathe, and we then have the well known slide-rest. The merit of this invention is generally ascribed to Henry Maudslay, and though recent researches have perhaps thrown some doubt upon his being the actual inventor, there can be no doubt that we have to thank him for its introduction.

Fig. 4

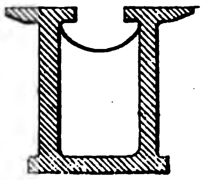
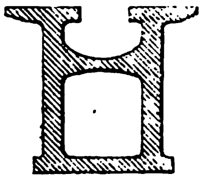


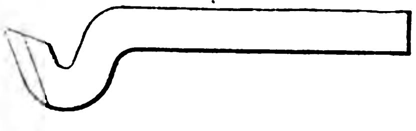
Fig. 5



It may probably be asserted that in this combination of the mechanical guidance of the material and of the tool, we have the principle of every machine tool of the present day, no matter how complicated, and that practically they are all derived from the lathe at the stage to which we have now followed it.

The screws which give motion to a tool in a slide-rest were first—as they still are in small lathe—worked by hand; but it was not long before they were automatically connected with the spindle of the lathe, thus giving us the ordinary modern sliding and screw cutting lathe, probably as nearly perfect a tool for its particular purposes as can be devised. Such a lathe is represented in Fig. 3.

Fig. 6

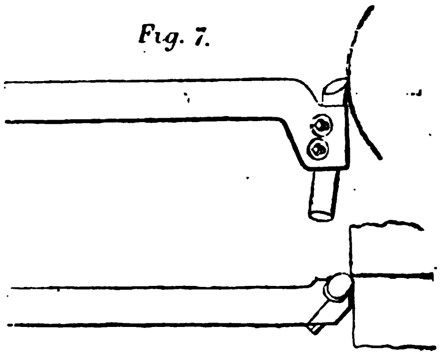


Let us suppose that it is now required to drill a hole. We place our drill in a chuck on the end of the lathe spindle, and either support the object to be drilled against a plate on the movable headstock, or bolt it on the saddle of the slide-rest and feed it up to the drill by one or other of these means. Such a process is satisfactory enough when the work to be drilled is small; but it is clear that the size is limited for want of sufficient height, and and it is, moreover, difficult to adjust in position.

Now, imagine the lathe turned upon end, the headstock being uppermost, with a plain horizontal table to support the work—capable of vertical motion on the bed. No difficulty will then exist in adjusting it in position, and by slightly modifying the form of the framework, it can be adapted to receive work of large size. Here we see the modern vertical drilling and boring machine. When the work is large it will be easier to feed the drill down to the work, than the work up to the drill. For convenience of belting from line shafting the pulley or rigger is taken off the now vertical spindle, and placed on a horizontal one, coupled by bevelled gearing to it. One development of this machine is the radial drilling machine, with the drill-spindle at the end of a radiating arm; not to mention many other varieties of form which have emanated from the simple upright drill. It could perhaps be said that the blacksmith's common upright bench drill is the parent of the modern machine drill, but it may with more justice be traced to the lathe as just suggested.

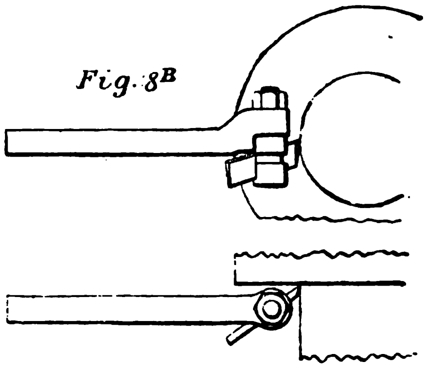
Returning to the slide-rest lathe: We will suppose that we have a small object upon which we want to form a flat surface. We attach it to the face plate, fix a tool in the slide-rest, and feed it across the bed of the lathe; and all being in good order we get a practically level surface; but it is obvious only a small piece of work can be operated on in this manner.

Fig. 7.



We have here the reciprocating motion in one plane of the material to be operated upon, and the feed motion of the tool in a straight line in the same plane, which is all we want for a planing machine. Let us now turn the lathe upon end again, only on the opposite end this time;—stand it on its head, in fact. This position is clearly much more convenient for supporting the work to be planed, as it now lies on a horizontal surface, and let us replace the limited reciprocating stroke given by the rotation of the spindle, by substituting for the lathe headstock a bed, with a carriage or saddle on which to fix the work, capable of sliding to and fro upon it to any required distance. We then have unlimited length of stroke for the work, adjustability for height by means of the bed of the lathe and slide-rest carriage, and feed of the tool by the cross slide; and this, after making a few obvious and convenient alterations in the arrangement of the framing, and supplying suitable driving gear, is the modern planing machine.

Fig. 8B



Now, take this planing machine, fix the tool in the place before occupied by the work, and the work in the place of the tool, so that the tool has the reciprocating motion, and the work the slow cross-feed, and we have another kind of planing machine, commonly called a shaping machine, from its great adaptability, with a few simple modifications, to cut a variety of planes in various relative positions to each other upon the same piece of work, or, in fact, to shape it. Such a tool, by further modification still, will cut slots or other comparatively difficult operations, and is the well-known slotting machine.

The modern milling machine, which is a tool of almost inexhaustible capabilities, in its simplest form is merely the headstock of a lathe with a circular cutter fixed upon the end or nose of the spindle, and the material held in a suitable manner in the slide-rest, and then by feeding the work under the cutter either a groove can be cut or a surface planed; and if a rotary motion be imparted to the material as well as a longitudinal, spiral grooves or cuts are the result. While on the subject of milling machines, it may be mentioned that some are made in a form similar to that of a planing machine, and by their means surfaces of a great length can be milled. One firm, makers of machine tools, uses such a milling machine for the planing or facing of the beds of lathes. The bed of a screwcutting lathe has six distinct surfaces which have to be planed: the two flat tops, the undersides of the two V's, and the two inside edges. The machine has six cutters working simultaneously, and the lathe-bed is only passed once through to complete the operation.

Valuable as a milling-machine is, it was not till a satisfactory method of sharpening the cutters was devised that it came into any extended use. The old plan was to soften the cutter, sharpen the teeth with a file, and reharden; this always distorted the shape, to say nothing of the fact that it was almost impossible to file the teeth true in the first instance, and in consequence perhaps only a third of the teeth were actually doing work; this caused them to become rapidly blunt again, and the operation of softening, filing, and hardening had to be repeated, to the great detriment of the temper of the steel, which, in fact, was soon rendered valueless. By the present system, after a cutter has been properly shaped it is hardened and tempered once for all, and never sees the fire again. After hardening, it is sure to be warped somewhat; it is therefore placed upon a mandrel in a special grinding machine, and each tooth passed in succession under a small emery wheel revolving at high speed; this not only sharpens each tooth, but renders the wheel absolutely true, so that all the cutting edges do an equal share of work, and have each the same clearance angle. As soon as it becomes blunt it is only necessary to regrind the teeth again as before, and this operation can be repeated until the teeth are so worn away as to be no longer of any use. This ingenious little apparatus is the invention of Messrs. Smith and Coventry, of Manchester, and it is not too much to say that it has made all the difference between the milling-machine as a clever toy, and as one of the most valuable tools in an engineer's shop. The milling machine, in its latest developments, has usurped many of the functions of the planing, slotting, and shaping machine, and even of the lathe, more especially for work of a small character. For copying work, such as making any number of pieces of irregular form all absolutely to one pattern, such as parts of gun-locks, it is specially valuable.

Reverting again to the lathe; the old French lathes are very interesting, curious, and ingenious; in fact, the French until recently were far ahead of us in this respect; but of late years their practice in lathe design has not kept pace with the times. Some of their lathes with what are called traversing mandrels for cutting screws, made a hundred years ago or more, are beautiful specimens of workmanship, and there are not a few still in existence perfectly capable of turning out good work. There is, in the Museum of Arts and Manufactures in Paris, an old lathe preserved, which practically anticipates the modern screwcutting lathe, though of course in a comparatively clumsy manner.

Let us now direct attention to the points of difference between English and American lathes. One of the most prominent of these, is the form of the bed; the English being made with two large flat surfaces to receive the wear of the slide-rest carriage, the American only two, and in rare cases four, little half-round beads for the same purpose; and as the greater portion of this wear takes place in one part of the bed only—viz., near the headstock, the bed soon wears hollow in that place. Again, the English carriage is kept down by what are called "gibbs" screwed on it under the V-edges of the bed; the American, even in lathes by their best makers, is usually kept down by weight only. The supposed origin of this form of bed in America is rather curious. The early lathes had wooden beds, which answered well enough till the slide-rest came into use; then upon the top of the bed strips of half-round iron were screwed down and filed into truth; this gave, when new, a fairly satisfactory bed for the carriage with the minimum of surface to be fitted, which, as it had all to be done by hand, was a laborious and tedious operation. The simplest way to keep the carriage down was clearly to weight it, and this primitive form is reproduced in iron in their best lathes to the present day. They are consequently unable to take the heavy cuts customary in England; and, indeed, to judge from the appearance of most of their slide-rest tools, they only look fit for scratching the work. We must not, however, decry the American lathe too much, for we have to thank them for a great part, if not the greater part, of the ingenious machine tools of the present day, the milling machine prominently among the number, and the tools turned out by their best makers are exquisite pieces of finished workmanship, by which mere surface-finish to catch the notice of the ignorant is not meant, but accurate fitting of working parts.

The usual way of making a lathe-bed is quite wrong in principle. A little consideration will show that it is a girder subject to torsional strain, and the ordinary form, shown in Fig. 4, which consists of two I-shaped joists united at intervals by cross-pieces, and not joined at the bottom, as shown in the diagram, is little adapted to resist such strain. The proper form would be of a box section, as shown by Fig. 5, and some are now made in this manner.

While on this subject, it may be said that the designs of the top of the ordinary planing-machine bed is most unsatisfactory. It consists of two V-troughs, in which corresponding V-pieces on the underside of the carriage slide. The surfaces of these V's are usually quite inadequate in extent for the friction they have to endure, consequently the heavy pressure and wedge-action of the V's squeeze out the lubricant, and they soon deteriorate in truth; broad flat surfaces with V-edges for "gibbs" would be far more serviceable and accurate.

No matter how admirably our machine tools may be designed and manufactured, they are perfectly useless unless a certain insignificant-looking part is properly cared for—allusion, of course, being made to the actual tool or cutter. It must be of the best steel, properly hardened and tempered, and its cutting edges accurately formed to the correct angle, *and, above all, sharp*, if good work is to be turned out.

The amount of ignorance and prejudice existing among workmen on the subject of the angles of cutting tools is surprising. The apprentice, after a long course of failure, succeeds in grinding his tool so that it will cut, but *why*, he probably could not tell you. It is no uncommon thing to see a slide-rest tool simply tearing or grubbing off the material by mere main force. Not long since the author saw, in a shop, a latheman take his tool to the grindstone to sharpen, and when he had replaced it in the rest, out of curiosity he examined it; the tool was at work on wrought iron, and was perfectly flat on the top with an obtuse angle. I need not comment on the wretched surface left on the material by such an instrument. Of course it removed something, because it was made of hard steel, and the unfortunate material was only comparatively soft iron, and one of the two had to give way; but how it removed it was quite another question. Fortunately this subject is now beginning to receive its due amount of attention in many machine shops, and it is found that when the tools are formed to the proper angles in the first instance, and are always ground accurately to the same angles, not only is the character of the work greatly improved in truth and finish, but the tools will take a heavier cut, and a coarser feed, with less expenditure of power.

The correct angles for the cutting edges of tools for various materials are now perfectly well known: there is no need to make rule of thumb experiments to discover them. It is, however, quite impossible to grind a tool to a given angle with any approach to accuracy *by hand*.

The tool *must* be rigidly held in a slide-rest, which is capable of adjustment to the required angle by means of a division plate, and be traversed to and fro across the face of the grindstone or emery wheel by such slide-rest, water being supplied by an adjustable tube to the edge of the tool the whole time, to preserve the temper. By grinding the tool at sufficiently frequent intervals, a few passes across the stone are only necessary each time, and by these means the tool is always kept in good condition and its angles accurate.

While on the subject of tools, we may note that the ordinary forged slide-rest tool is rapidly being superseded by small cutters held in adjustable tool-holders. The familiar forged tool (shown in Fig. 6) is of course known to us all. Now this is, in the first place, not an easy form to forge accurately; it takes some time, and the frequent heatings necessary in the process tend to do anything but improve the quality of the steel of which it is composed. Again, it is needless to remind you, that for effective work, the point should be at the same height as the lathe centres. When the tool is sharpened the surface is lowered, and the point is then below the centres; the resource is to block the tool up with a strip of anything at hand, which may be too thin or too thick. If the work in the lathe is of small diameter, it is most important to have the point accurately at the height of the centres: if lower it will tend to dig into the work, and if higher there will be great friction caused by the edge below the point rubbing against the work, and it will be impossible to make a clean and good cut. When, after successive sharpenings the tool is worn down halfway, it is of no further use. It can scarcely be reforged, as the shank would be too short, to say nothing of the further injury to the quality of the steel, and it is probably cast on one side as valueless. When a toolholder with cutters is used, the holder takes the place of the shank of the forge tool, and is made once for all.

The cutters are simply short pieces of steel cut off bars of suitable section, with their ends accurately ground to the right angle. They can be adjusted to the correct height in the holder in a moment by means of a centre gauge placed on the slide-rest; and as soon as they become dull they only require to be slightly ground on their ends, and this grinding can be repeated until the cutters become too short to be held in the holder, when they are thrown aside; but the waste of material in this case is most trivial as compared with the waste of throwing away a forged tool.

The tool-holders made by Messrs. Smith and Coventry, whose milling cutter grinding machine was previously described, are of very excellent design, and diagrams of them will well illustrate the subject. (See Figs. 7 and 8.)

It will be seen that in the holders, which are formed to receive cutters made from round steel, the cutters are only adjustable for height; but in the others, called swivel holders, the cutters can also be set at various angles, which is a valuable feature. Such tool holders and cutters are quite as useful in the planing and shaping machine as in the lathe. The round cutters are chiefly used for roughing off; and the swivel cutters, made of V-section of steel and of various forms of cutting edge, for finishing cuts and for getting out sharp angles and corners. Such cutters, when made of good steel, formed to a correct angle and kept sharp, leave the surface of the work with a high finish, which any subsequent barbaric treatment with emery would only mar.

There is a prevalent idea that cast iron and brass cannot be removed in shavings like wrought iron or steel, but must be scraped off; that is, the cutting angle of the tool must be about 80° or 85°. This is very erroneous. It is not contended that so acute an angle would answer as may be employed upon steel or iron; but cast iron or brass can be removed in shavings with a comparatively acute edged tool—about 65° or 70°, for instance—with less labour and with a better finish to the surface than could be obtained with obtuse angles. When a very obtuse angled tool is used, one of its sides will be a perpendicular to the surface of the work, and it is difficult under such circumstances to avoid "chattering," which is fatal to a good finish or fit.

With regard to drills, there is no question about the immense superiority of twist drills over the ordinary flat drill. The flat drill is not a cutting tool, it is simply a scraper, and removes the material by sheer brute force. The twist drill, on the contrary, has a true cutting angle at its edge. Twist drills are, however, worse than useless unless they are ground mechanically; it is impossible to grind them accurately by hand, and it is better to use a well-made flat drill than a badly-ground twist drill. This will be found to account for the latter not being so popular as they should be. The cutting edges of a twist drill should be absolutely of the same length, and at the same angle to the axis, and the angles of clearance should be perfectly equal. This can only be accomplished in a properly designed mechanical grinder, no hand-grinding can ever effect it, grinding lines and all such aids being little better than useless. A twist drill with its edges properly formed will make a hole through which the drill itself will only just pass, and it will take a heavier feed than the flat drill, and at less expenditure of power.

In conclusion, attention may be drawn to the comparison between the little watchmaker's lathe now before you, and the gigantic lathes represented by some of the photographs on the wall, as affording an instance of the great variation in size of the same tool, the operations performed in each being practically of the same character.

COLOUR IN ELECTRO-GILDING

IT is of the greatest importance to possess a knowledge of the art of regulating the current and general working of hot electro-gilding liquids, so as to make the process useful in producing not only deposits of gold, but those of any desired colour. As a general rule, it will be found best to obtain any excessive colour by additions to the bath, and not by attempting to work it up to this by the current or temperature. Thus, to obtain red or green gold of decided colour it will be necessary to make additions of acetate of copper and nitrate of silver. But if it is not required to perpetually gild in this colour, or at least until all the added metal is worked off, the bath will be spoilt for ordinary gilding. It is, therefore, always wiser, when excessive colour is required, to either make up a separate solution for that particular colour, or to make the main bath up in that manner if the work is always to be carried on.

To make up a bath for red gilding, grind a little of the acetate of copper (crystallised) to powder, dissolve in water, and add to the bath, with stirring, every evening as much as may be required. In a new bath, where there will be no troublesome sediment to disturb, the addition may be made at any time, and the quantity augmented if the colour is not sufficiently deep. It must not be forgotten, however, that gold so coloured is not so fine as a yellow gold. Attention should be given to some of the directions which follow, so that the battery power and temperature may be regulated to assist in the production of deep colour, it being important that too many foreign substances be avoided in a good bath.

To obtain green and white gilding the addition is a solution of the crystallised nitrate of silver. This is added in the same way as the copper. A very little (a few drops) will generally produce green gilding, and a little more white.

To deposit a gold of pink appearance is a more troublesome matter. The surface is first coated yellow, and then thinly red, and over this is produced an exceedingly thin coat of silver in a silvering solution. Such surfaces are very lasting, and should be burnished.

A good cyanide gilding solution should be of sufficient strength to allow of its producing from a pale and poor looking deposit to a deep and nearly red rich gold. For such purposes the solution may even contain as much as 1½ ounce of gold per gallon, but over this it is not advisable to go, for the reason that the paler tints are not readily obtainable. The poorer solutions will produce fairly pleasing tints when the current is strong and the temperature high, but the darker shades are very apt to have a dingy appearance, instead of that mellow and clear surface which is the chief aim of the practiced gilder.

A dead gilding will be produced by the addition of a little of the fulminate of gold in solution to the bath immediately before gilding, or dip the articles (brass and copper) before gilding in a mixture of sulphuric and nitric acids.—*Watchmaker.*

PHOTOGRAPHY BY THE MAGNESIUM LIGHT.*

SOME experiments have been recently published on the use of bottles of oxygen in which to burn fragments of magnesium riband, to take portraits by the magnesium light. An objection is the the trouble and cost of making the oxygen, and that means have to be adopted to diffuse the light near its source. The objection to burning the riband in air is that the exposure is longer, and the burnt ash has a tendency to drop off and put out the light before the selected length of metal is consumed.

Some years ago I had occasion to use the magnesium light by night, and overcame the difficulties by the adoption of one part of the principle of Larkin's magnesium lamp. The method may be thus explained. On the top of a firm and solid table is placed a base-board supporting a wooden upright some seven or eight feet long, consequently reaching nearly to the ceiling of the room. At the top is a kind of little brass funnel with no neck, and a large opening where the neck should be. This brass inverted cone was no larger than an egg-cup, and its lower opening was about as large as a fourpenny piece. A tin spirit lamp, with a horizontal neck and flame, is placed below, so that anything falling through the funnel must pass through the flame, yet just miss touching the wick. The combustible substance was magnesium powder mixed with sand. One thimbleful of the powder, for instance, is mixed with two of sand with a spoon or bit of wood on a sheet of paper; then, the sitter being in position and all being ready, the mixture is poured all at once into the funnel. A long sheet of flame of one or two seconds' duration is the result. If the picture prove over-exposed the proportion of sand has to be increased in the next trial, or that of the magnesium powder correspondingly diminished. When once the right proportions are known, portrait after portrait can be produced, properly exposed with dead certainty. No cap is necessary to the lens, provided a candle only is used for the normal illumination of the room, and it is not placed so that an image of it can be thrown by the lens into the camera. The proportion of magnesium powder regulates the proper exposure. At first there was a difficulty, and one only, with this simple apparatus, and that was that the aqueous vapour from the flame condensed on the lower parts of the brass cone, and the powder stuck to the neck of the wet funnel, sometimes blocking it and arresting the flow of illuminating material altogether. The neck of the funnel was therefore cut off, and the lower opening of the cone made rather large. It would be an improvement to use something on which aqueous vapour has less tendency to condense than upon cold brass. The brass, however, was subsequently kept hot by fixing the spirit lamp nearer to it than in the first experiments.

The larger the proportion of magnesium in relation to the sand the longer the flame and the shorter its duration. With a very rich proportion I once had a flame seven or eight feet long, reaching the base-board and burning its surface. The long flames give the necessary diffusion of light, and a white sheet on the opposite side of the sitter improves the shadows. The finest artistic effects of light and shade on the countenance of the sitter can be obtained by this method when the lamp is placed in the proper position.

The sitter need not be fatigued with focussing operations. A candle placed where his face will come will do to focus upon. In fact, it is a capital method for the comfort of the sitter, who must not look in the direction of the coming flame, lest his eyes be dazzled by its magnificent flash, which, however, lasts but a second or two.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthy meeting of this society was held on Wednesday evening, the 20th inst. The following papers were read:—

(1) "The Great Storm of January 26th, 1884," by William Marriott, F.R.Met.Soc. This storm was remarkable for its violence and large area, as well as for the unprecedentedly low barometer reading at its centre. The author has prepared isobaric charts for each hour from noon on the 26th to 3 a.m. on the 27th, and by this means has tracked the storm across the British Isles. The centre of the depression appears to have first reached the north-west coast of Ireland at noon, and passed in a north-eastly direction over the north of Ireland and across the middle of Scotland, reaching Aberdeen about midnight. Its rate of progress was therefore about 30 miles an hour. A violent gale was experienced all over the British Isles, the greatest hourly velocity of the wind being 68 miles at Valencia at 11 a.m., 70 miles at Holyhead at 2 p.m., 63 miles at Falmouth at 3 p.m., 69 miles at Armagh, and 59 miles at Aberdeen at 5 p.m., 58 miles at Greenwich from 5 to 7 p.m., and 76 miles at Alnwick at midnight. Thunderstorms occurred on the south-eastern side of the depression, and travelled across the south of Ireland and England at the rate of about 30 miles an hour. The lowest readings of the barometer (reduced to sea-level) yet reported were 27·32in. at Kilireggan at 8.30 p.m., and 27·332in. at Ochtertyre, near Crieff, at 9.45 p.m. In the southern part of England directly after the minimum had occurred there was a very sudden rise in the reading of the barometer, in some cases amounting to ·08in. in five minutes. From an examination of previous records it appears that there has never before been so low a barometer reading as 27·32in., so that this storm may be considered as one of the most remarkable that has occurred in the British Islands.

2) "The Height of the Neutral Plane of Pressure and Depth of Monsoon Currents in India," by Prof. E. D. Archibald, M.A., F.R.Met.Soc.

(3) "The Sunrises and Sunsets of November and December, 1883, and January, 1884," by Hon. F. A. Rolls Russell, M.A., F.R.Met.Soc. The author gives a very interesting account of all the special features of the remarkable sunrises and sunsets which have been observed from November 8th to February 2nd. The following are stated to be the marks distinguishing the peculiar sky haze from cirrus:—1. It is commonly much more evenly spread over the sky than cirrus. 2. It is visible (except when very dense or in the neignbourhood of the sun) only about the time of sunrise and sunset. During the day not the faintest trace obscures the clear azure, whereas cirrus becomes more distinct with more daylight. 3. When actually glowing with bright colour its loses its wavy appearance. 4. It has no perceptible motion, unless perhaps when watched through a long period. 5. It does not interfere with the clear definition of the moon or brilliancy of the stars. 6. It lies almost without exception in long streaks, stretching from between south-south-west and west-south-west to between north-north-east and east-north-east. 7. Its radiant point lies not on the horizon, but far below it. 8. If both cirrus and sky-haze be present, the sky-haze begins to shine with a red light soon after the cirrus has ceased to glow above the western horizon. When cirrus is present, however, there is in general a reaction of effects. 9. The sky-haze is destitute of the fibrous twists and angular branches of cirrus, and since the sunlight leaves it in regular progression, it must be stratified at the same uniform level. 10. It has always been visible on every clear day for more than two months, and has been quite independent of wind and weather.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE fifth meeting of the session took place on Monday, 18th inst., the Rev. T. E. Espin, B.A., in the chair.

Mr. Isaac Roberts, F.R.A.S., gave a description of his recent experience in photographing stars and nebulæ. His own investigations had, he said, been undertaken more with a view of testing lenses and apparatus, than with the hope of immediate success. The method he had adopted was to fix two, and sometimes three, cameras on the declination axis of his large telescope, and to take simultaneous photographs of a star-group or nebula, using similar plates, and allowing the same exposure to each. This method had also the advantage of enabling comparisons to be made of the qualities of dry plates for quick photography. He had not found the large lenses necessarily the best, and this was illustrated by a photograph of a considerable number of faint stars, including some of the shading of the great Nebula in Orion, which was taken by one of Ross's ⅜in. rectilinear lenses, whereas some of the photos taken by much larger lenses were wanting in definition.

The Chairman said the results obtained by Mr. Roberts were most valuable. The observatory at West Kirby had lately been furnished with one of Grubb's magnificent stellar cameras, with equatorial mounting and clock motion. It was now in working order, and he hoped shortly to give a satisfactory account of its performaece.

A paper by Capt. W. Noble, F.R.A.S., was read in reply to Mr. Peal's "New Theory of Lunar Formation," (published on page 490 of the ENGLISH MECHANIC). He was curious to learn how the "large volumes of water could emerge and flood the ice-crust, level it, and being repeated gradually raise the level" without leaving the sublunarian space, previously occupied by the water, void. Had Mr. Peal attempted, even roughly, to estimate the stupendous strain upon the lunar framework under such conditions? He could not, either, regard his reference to the fall of meteoric dust in our Polar regions, as in any legitimate sense explaining the very diversified tints which appear on the moon's surface. Everyone who has looked at the moon through a telescope, must be familiar with the light-green hue of the Mare Serenitatis, and the somewhat bluer green of the M. Humorum. Other districts also exhibited a variety of colours, so that the amount of meteoric dust, necessary to produce those effects, would have thrown the recent efforts of Krakatoa wholly into the shade. Moreover, it would be remembered that the photometric determination of the moon's light shows that her surface is nearer black than white. Nor did Mr. Peal seem to consider the recent researches of Lord Rosse, who had calculated that the moon must at times be heated to something like 500° Fahr., a condition that certainly did not obtain on the Himalayas.

Mr. W. H. Davies remarked that Capt. Noble's argument, based on the determination of the moon's light, seemed to have been anticipated by the theory of meteoric dust. But it struck him that this was only getting out of one difficulty into another, since, if the sun's rays were not reflected, they must be absorbed; and then what became of the snow?

Mr. W. H. Gaze, F.R.A.S., read a paper on "The Value of Weights and Means as applied to given Periods of a Variable Star." He had been struck with the importance of having some reliable and universal method of reducing any number of given periods of a variable star, not differing too widely apart, and was led to investigate certain formulæ devised by two members of the society. He came to the conclusion that some weight ought to be given to each observation, and gave a formula for combining the weights and given periods together. He thought, however, that if the weights were not correctly given, a simple arithmetical mean was the best method.

Writing on the subject of the Taurid meteor shower, Mr. H. Corder said it was necessary to refer to this shower, as it seems at first sight to form part of the Taurid system; but, after carefully mapping a large number of radiant points noted by various observers, it seemed to be possible to distinguish certain aggregations of positions. Mr. Denning gives as a mean 44°½ + 22°, but two showers seem so distinct that he would give them as 46° + 27° and 40° + 21°. Besides these, are a number of scattered radiants in Aries and Musca. The Muscids are noteworthy as being very often fine meteors, and this seems to distinguish them from the Taurids, which are rather small.

Mr. A. Stanley Williams said he had examined the head of Comet Pons-Brooks with a power of 110, and there was apparently a central point brighter than the rest. At times nearly the whole of the head was sprinkled with brighter points or condensations, like a star cluster, but none of these were so bright as the central point. The comet bore a power of 150 well, and the brightness of the points was intensified; but the central point, which was not

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By W. H. HARRISON, in the *British Journal of Photography.*

worthy of the name of a nebula, was not then much brighter than the others.

A simple equatorial mounting for small telescopes, by Mr. W. Harding, was shown and described, and several photographs of stars and nebulae were handed round. Dr. Wm. Huggins, F.R.S., and the Rev. S. J. Perry, F.R.S., Stonyhurst, were elected associates.

SCIENTIFIC NEWS.

In an interesting lecture delivered last week before the Leeds Philosophical and Literary Society, Prof. Ball, the Astronomer Royal for Ireland, spoke of celebrated comets, present and modern, great and small. After describing the appearance and orbits of some of the most remarkable comets, Prof. Ball referred to the shower of shooting stars which was seen in 1866, and mentioned the supposition that these meteorites were the remains of tails of comets.

On Monday last, Mr. G. J. Romanes delivered a lecture on "Instinct" to the members of the Birmingham and Midland Institute, in which, after defining the differences between actions properly called instinctive and those due to reflex muscular or nervous motion, and also those intelligently directed, he dwelt upon the two causes to which instinct is to be attributed, namely lapse of intelligence in actions originating intelligently, becoming by repetition automatical, and natural selection, these two causes acting frequently in combination. He afterwards spoke of the plasticity of instinct, showing, by numerous illustrations, that however perfectly formed the instincts of animals might be, they were capable by change of circumstances of being deflected and even altogether changed. In the case of the dog, for instance, the spirit of fierceness and self-reliance which was characteristic of all wild dogs had been changed by domestication to one of docility and faithfulness, and a sense of dependence upon his master, and in addition new instincts had been developed, such as those of pointing, retrieving, sheep-tending, and guarding property, all of which were strongly inherited. Prof. Romanes referred to some of the difficulties in the theory of evolution, of which at present he admitted inability to furnish a satisfactory explanation.

A series of Gilchrist science lectures is to be delivered on Tuesday evenings, commencing March 4, at the Royal Victoria Coffee Hall, Prof. H. G. Seeley leading the way next Tuesday with a discourse on Ancient English Dragons. On March 11 Mr. W. Lant Carpenter, B.Sc., will discourse on Air, and why we Breathe; followed on March 18 by Mr. P. H. Carpenter, D.Sc., with Fossils, and what they Teach us. On March 25 Mr. E. Clodd will lecture on the Working Man [illegible] Years Ago; April 1, Mr. Ranyard, Sec. R.A.S., on Planets; and April 8, Mr. J. W. Groves on the Dangers and Safeguards of Beauty in Animals.

At the [illegible] annual general meeting of the Hertfordshire Beekeepers' Association, held at Hitchin last week, a satisfactory report and balance-sheet were presented. The thanks of the committee and members were awarded to the Rev. F. G. Jenyns, Rev. J. L. Seager, hon. sec., and Mr. [illegible] P. Sambels for the lectures they had delivered in various parts of the country. The Rev. F. G. Jenyns said that from six hives he had obtained [illegible] of super honey, and, according to the report, Miss Gayton, of Much Hadham, had cleared in 1883 upwards of £[illegible], selling honey in sections at 1s. [illegible] per lb., and extracted at 1s. per lb. This society pays an expert to visit the members and examine their hives.

The output of coal in the United Kingdom is stated to have reached, last year, the high total of [illegible] tons, or an increase of more than [illegible] per cent. on the previous year's total. According to the late Prof. Jevons' estimate, the quantity raised in 1883 should have been [illegible] tons, so that the actual output was [illegible] tons less.

The Commissioners on Technical Education have, it is understood, concluded their labours and will meet again only for formal business. The report will occupy five volumes, and it is stated to be impossible to give a *résumé* of the conclusions which would not be misleading, or at least, not intelligible in the absence of the explanatory details.

A report on the effect of heavy sizing in cotton weaving upon the health of the operatives has been issued. It states that the balance of evidence is in favour of harm resulting not to strong and vigorous constitutions, but to those who are weakly, or have tendencies to rheumatic or pulmonary disease, and recommends that processes by which large quantities of size can be incorporated with the warp without the addition of dust or moisture should be generally applied, and that effective ventilation should be adopted.

Letters from Reikjavik up to the middle of February report a mild winter, with little snow, but rain and heavy southerly storms have been frequent.

News has been received in St. Petersburg from the Meteorological Expedition at the Mouth of the Lena reporting "all well."

Corrosive sublimate is gaining ground amongst surgeons and others as a most efficient antiseptic.

M. Pasteur's son-in-law has published a work in which he relates in much detail the history of the great Frenchman's discoveries, and furnishes many lively biographical anecdotes. The book is entitled "Histoire d'un Savant par un Ignorant."

M. Ferry has requested the Academy of Sciences to appoint three delegates to the International Commission which is to meet in Washington in October to determine the choice of a prime meridian.

At a meeting of the Scottish Royal Physical Society, held last week at Edinburgh, the geological structure and age of the Harz Mountains formed the subject of a paper by Mr. H. Mowbray Cadell, B.Sc., of H.M. Geological Survey of Scotland. Dr. Traquhair made some remarks on the fossil fish called *Megalichthys*, found at Burdiehouse, and said it was his belief that it was a different species from the *Megalichthys* of the coal-measures. An interesting paper was read by Prof. J. Cossar Ewart on "The Principles of Classification in Natural History." In drawing up a system of classification, it would, he said, be necessary to distinguish adapted from essential characteristics, and to remember that no arrangement could be natural if it was not genealogical. The system at present in use was a natural one, but it was somewhat disjointed. For its improvement a number of suggestions were submitted, it being claimed for the plan proposed—which was based on evolutionary principles—that it was more simple and philosophic.

The gift of the *Alert* to the United States for the use of the Greely Relief Expedition is a creditable act on the part of the English Government, and it has met with gracious and hearty acceptance. Many years ago, when the *Resolute*, abandoned by English Arctic explorers, had floated free and been brought by an American whaler to New York, the United States Government refitted her completely, and then sent her as a gift to the Queen. Quite recently, when the *Resolute* was broken up, her Majesty caused a very handsome desk to be made from her timber, and presented it to the American President. The best wishes of this country will go forth with the *Alert*, that she may add yet another chapter to Arctic exploration of which the two nations, but one people, may justly be proud.

At a meeting, last week, of the chemical section of the Glasgow Philosophical Society, the second triennial Graham lecture, prepared by Dr. Angus Smith, was read by Professor Ferguson, the subject being "The Life and Work of Thomas Graham, late Master of the Mint."

A memorial window has just been erected in Newburn Church to the memory of the late William and Thomas Hedley. The subjects chosen by the artist are "Noah and his three sons building the ark," illustrating the genius given to man, and the "Parable of the Talents," typifying the good use of the genius and wealth that man is blessed with. At the bottom of the [illegible] plate is the representation of a railway engine, and underneath are the words, "Drawing of the first locomotive invented by William Hedley, originally placed in Kensington Museum."

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, *81, Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clatter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

THE RECENT AWARD OF THE R.A.S. GOLD MEDAL—THE AFTERGLOW—SCINTILLATION OF THE STARS AND MAGNETIC STORMS—REPORT OF THE HARVARD COLLEGE OBSERVATORY—THE MOON'S MOTION—THE GEOLOGICAL SURVEY OF THE HOLY LAND—MEASURING THE POWER OF A TELESCOPE—THE INTERNATIONAL INSTITUTE FOR PRESERVING AND PERFECTING WEIGHTS AND MEASURES.

[[illegible].]—The award of the gold medal of the Royal Astronomical Society this year to Mr. A. A. Common, for his results in celestial photography, will, I think, commend itself generally to astronomers as a well-deserved recognition of the large quantity of really excellent work done by its recipient. The great and lamented American physicist, Professor H. Draper, had previously photographed the nebula surrounding θ Orionis with very remarkable success; but his results were quite surpassed in the altogether wonderful production by Mr. Common which was exhibited last year at the March meeting of the Royal Astronomical Society (English Mechanic, Vol. XXXVII., p. [illegible]). Moreover, Mr. Common, in pursuing the photography of the stars and planets, has incidentally rendered services of a very high order to the theory and practice of the arrangement and mounting of large telescopes: his devices for diminishing friction in a great equatorial, and for insuring the rigidly equable motion of its driving clock, indicating mechanical abilities of the highest order. Mr. Common only affords another illustration, if such were needed, of the fact that all our best astronomical work, outside of the mere monotonous "grind" of meridian observations, is performed by men entirely unsubsidised by the State: whose aim is the pure and lofty one of the pursuit of scientific truth for its own sake, and not for what can be made out of it by advertising, quackery, and puffery.

In the number of the *Précurseur*, an Antwerp newspaper, for February [illegible], I find a paragraph of such interest in connection with the recent wonderful displays of afterglow, that I am tempted to translate it for reproduction here. It is anonymous; but I feel pretty sure that it is the production of an eminent Belgian astronomer.

"Twilight Illuminations.—The phenomena seems to diminish slowly. As to its explanation savants are at their wits' end. There are as many opinions as there are people. But we are authorised in believing that it was equally manifest towards the end of the 16th century. We read in the history of Titian's life, that when he died the entire sky appeared red. This appearance is shown in the painting by Robert Fleury, which figures in our modern museum, and which represents the death of the Venetian painter. We see in the distance Venice and the cupola of St. Mark, which seems enveloped in an immense conflagration, of which the glow rises towards the zenith. When Titian died, that is to say in 1576, Shakespeare was twelve years old. The phenomenon should have been, at this date, equally visible in England, and perhaps, as at present, all over the world; and it [illegible] have been under the influence of this recollection of the time of his boyhood, that the immortal English poet made Glendower say, in "Henry IV.," act iii. scene 1 (Here I quote, not from the French, but from Shakespeare himself): 'At my nativity, the front of heaven was full of fiery shapes, of burning cressets; and at my birth, the frame and huge foundation of the earth shaked like a coward.' Failing any meteorological observation at this epoch, these coincidences are curious, and there seems to result from them a strong probability that this is not the first time that the sky has clothed itself with this wonderful light." Now my object in quoting this paragraph is briefly this: A great deal has recently been said about the connection between the late remarkable chromatic phenomena and the eruption of Krakatoa in Java on the 27th of last August, and I am very curious to know whether any authentic account is extant of a volcanic eruption of any sort at or about the date of Titian's death? I know, of course, that Vesuvius was quiescent between 1538 and 1631, and that no noteworthy eruption of Etna occurred from the classical ages until 1669; but America was pretty well known at the end of the 16th century, having been discovered some 80 years previously; and it is conceivably possible that such an occurrence as the eruption of one of the volcanoes of the Andes may have been recorded by some voyager of the period, assuming such a thing to have occurred;—a remark which would equally apply to any violent volcanic action in the Eastern Archipelago of Asia, and, in fact, to such action in any observable part of the navigable globe. Do then, any such records exist? Will anyone who can spare the time, and has access to early accounts of voyages and travels look this question up? Its solution might render a real service to science. It is useless to hope for the existence of any meteorological records, properly so called. Meteorology was even in a more inchoate and imperfect condition at the end of the 16th century than it is at the end of the 19th —although, perhaps, this isn't saying much.

The mention of Belgium suggests to me to remark that M. Ch. Montigny, of Brussels, our first living authority on the subject of the scintillation of the stars, has recently made a most remarkable discovery, of which more will certainly be heard. It is pretty well known that the twinkling of the stars is materially aggravated by the presence of the Aurora Borealis; but M. Montigny has shown, by the comparison of a very large number of observations of the stars, with the magnetic records contained in the *Bulletin* of the Royal Observatory at Brussels, that abnormal scintillation corresponds with absolute accuracy in point of time with great magnetic disturbances; albeit no vestige of an aurora has been anywhere recorded! M. Montigny's observations were made with his singularly ingenious scintillometer, in which the telescopic image of the star is converted into a circle of light by reflection from a rapidly-rotating glass disc; just as an incandescent stick whirled rapidly round forms a seeming fiery circle. This question, however, is too important to be dealt with in such a fashion as as this; and I must hence content myself with the bare mention here of his latest advance in it.

Yet another annual report (the thirty-eighth) of the Director of the Harvard College Observatory has reached me through a friend, and once again I read Professor Pickering's account of the steady pursuit of the excellent and enduring work carried on by himself and his zealous assistants. Eclipses of Jupiter's satellites continue to be observed photometrically, and a very ingenious method of observing occultations and transits of the satellites has been devised by the aid of a double image micrometer. This enables the time of these phenomena to be determined within about nine seconds; which is less than the probable error of observing an eclipse by the old method. Charts of stars are in the course of preparation for the establishment of standards of stellar magnitudes. The meridian photometer continues in use, and its determinations of absolute stellar magnitudes seem to be the most trustworthy ever yet obtained. Variable stars have formed an especial subject of study, and excellent and instructive star maps have been obtained by photography. The parts of the report dealing with meridianal observations, the distribution of time, and the determination of the difference of longitude between Cambridge, U.S., and Montreal, demand no special notice, as they only refer to work akin to that performed at other observatories. It is interesting, though, to note the names of no less than six ladies as assisting in the reduction of the observations made with the Great Equatoreal, the Meridian Circle, and the Meridian Photometer. It would seem that the guarantee of an annual subscription of 5,000dols. for five years given in 1878 has now expired; and an attempt is being made to raise 100,000dols. as a permanent fund, of which 50,000dols. are already promised. In the nominal list of subscribers, by far the larger portion, both ladies and gentlemen, of those who contributed in 1878 reappear; and it is as instructive as it is gratifying to read such entries as "A Friend, 10,000dols"—and so on. How is it, I may once more ask, that we find these noble-minded Americans offering such munificent donations for the advancement of science? The answer is not far to seek. They know that every cent will be expended in the prosecution of well-defined scientific work of enduring value, and that their liberal gifts will not be misused for the private pecuniary advantage of any mere advertising quacks, but devoted wholly and solely to the carrying out of legitimate astronomical labours. I will not believe so ill of my own countrymen as to imagine that they would not be equally liberal if they had the same guarantee that their money would be honestly expended. How comes it to pass, then, that in this great nation a few wealthy men do not raise among them the annual sum necessary to keep the "Committee on Solar Physics" going? The reason is not far to seek. An appeal for such a purpose must be made to persons possessing more or less knowledge of astronomy; and astronomers know, to a man, that the whole thing is a mere quack imposture, originated and maintained for the personal benefit of an impudent advertising little ring. Mr. Mundella (whose knowledge of astronomy is probably about on a par with that of the cab-horse who takes him down to the House), and the equally learned permanent Officials of the Treasury may be "worked" by the Brompton wire-pullers to rob the nation annually for their benefit; but merely as a matter of course, the latter could not—and they know they could not—raise the amount which they divide among them every year from any set of men possessing the most rudimetary technical knowledge of the subject which they are supposed to be investigating.

Query 52998 (p. 525) is very nearly meaningless as it stands. "George" has apparently been reading an account or description of that inequality in the Moon's motion known technically as the Variation, in some book which explains it but hazily. Regarding the earth, for our present purpose, or the centre of the moon's motion, the action of the sun tends to retard her velocity from New Moon to First Quarter; to accelerate it from First Quarter to Full Moon, to retard it from Full Moon to Last Quarter, and to accelerate it from Last Quarter to New Moon again. This, however, is very far from being the only inequality. There are several others, which notably affect her place in the sky. As for the assertion that "the moon's motion is slower than the earth's:" this, as it stands, is mere nonsense until it is stated at what point such respective motions are referred. The earth is travelling round the sun at a mean rate of some 18·5 miles per second; an interval during which the moon only moves some 0·64 miles in her path round the earth. Turning to "George's" string of questions (unanswerable here) about the Tides, if he will reflect that the earth turns 27·32 times on her axis faster than the moon goes round her, any body following the moon must seem to travel from East to West. The number of minutes the moon comes later daily to the meridian do *not* represent the number of degrees of a great circle moved over by the moon in her orbit in the interim; because such motion is oblique to the equator, on which time is measured. The path of the moon relative to the sun is shown in a diagram of my own on p. 307 of Vol. XVIII. Your correspondent had much better get, and carefully read, Proctor's "Moon," published by Longmans; which you reviewed on p. 615 of Vol. XXVII. The Lunar Theory is one of the most difficult subjects to present in a popular form, with which I am acquainted.

In common with every geologist in England, I am most anxiously awaiting the publication of Professor Hull's results of his survey of Palestine, to which reference is made in your "Scientific News," on p. 533. To say nothing of his other discoveries, the mere establishment of the fact that at the date of the Exodus, the Red Sea and the Mediterranean were continuous, must introduce most remarkable changes in the current interpretations of the Jewish tradition. So startling an alteration in the physical geography of a well known region, within historic times, tends forcibly to show the fallacy of those arguments as to the distribution of the human race, &c., founded on the (supposed) immutability of the superficial configuration of the earth since man first appeared upon it.

The method of measuring the power of a telescope devised and explained by Mr. Holmes (in letter 22362, p. 534) is really only a modification of that invented by Mr. Schäberle, which is described on p. 145 of your XXXVIIth Volume. I can only hope that Mr. Holmes's mode of proceeding may prove more *practically* accurate than I personally found that of the American astronomer to be.

Very many thanks to "W. H. W." (letter 22364, p. 535) for his information as to the status of the so-called "International Institute for Preserving and Perfecting Weights and Measures." I read the paragraph (quoted verbatim in letter 23331, p. 514) on which my query was founded, in one of the morning papers; and it will be seen by reference to it, that it contains no indication whatever that the "Institute" is a mere association of astrological fanatics. Had I had the slightest suspicion that this was the case, I should certainly not have intruded on your valuable space by any reference to their vagaries. However, I think somehow that the British yard and inch will hold their own as metrical units without either the aid of the "buried cubit," or of modern perversions of the utterances of the Prophet Zechariah.

A Fellow of the Royal Astronomical Society.

SATURN'S RING.

[22396.]—Will any of our astronomical readers kindly mention if they have noted anything unusual or unsymmetrical in the appearance of ring C, where it is projected on the ball, during the present season?

Hardwick Vicarage, Feb. 22. **T. W. Webb.**

OCCULTATION OF VENUS IN THE DAYTIME, FEBRUARY 29, 1884.

[22397.]—I am somewhat surprised that none of your astronomical correspondents have directed the attention of your readers to this phenomenon, which to an observer with a very ordinary telescope must be plainly visible.

The accompanying computations have been made in haste: but I think they are correct:—

	h.	m.
Beginning Feb. 29	3	6
Ending ,, ...	4	9

Angle from vertex at beginning 45° toward east.
,, ,, ,, ending .. 115° ,, west.
Least distance of centres........ 8·4′

The above calculation furnishes a good example of the partially-graphic process, of which I gave a succinct account in a recent number of the English Mechanic. For such as desire to solve the problem after this fashion I give the accompanying elements:—

Lat. 53° 3s. N. Long. 8m. 41s. W.

	h.	m.	s.
Planet's Hour Angle..............	0	35	22 W
Value of 10 divisions of latitude —parallax scale.............			·282
Moon below axis of projection of parallel ..			15·25′
Reduced Horary motion in R.A...........			32·75′
,, ,, ,, Dec...........			9·4′
Sum of semi-diameters			16·4′

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Feb. 22.

JUPITER, SATURN, &c.

[22398.]—On the night of Feb. 8th I watched the occultation of 68 Geminorum by the moon, and noticed that the star appeared to lose much of its lustre about five minutes before it disappeared. Also at the moment of disappearance there seemed to be a little splash of the rays of light around it. Having watched many occultations, and seen nothing like it before, I thought it might be as well to ask if others had seen anything of them in this or other cases. On January 8th I had a good view of Jupiter, the shadows of the first and third satellites being on the disc at once, about 10.30 p.m.; also the red spot being central at the time, and easily visible with 5¼ Calver mirror, power 112. The two unequally-sized jet black shadows of the satellites, the ruddiness and width of the equatorial belt, and at times the faint colour of the red spot, with other details, forming a sight not easily forgotten. During a splendid display of the planet on Feb. 24th, about six o'clock p.m., definition beinng nearly perfect, and much detail seen with surprising distinctness, the next dark belt north of the great one was seen to be divided by a narrow bright zone, and an ill-defined black spot was noticed on the northern edge of the equatorial great belt, this latter, by the way, being a good distance from the planet's equator apparently. When the red spot first appeared the lighter shading to the south seemed repelled by it; but lately the stronger great ball north has been affected in the same way. On this evening I saw Venus for the first time through the reflector, and, certainly, the whiteness of the image and total absence of colour, and the great distinctness, were very pleasing after being used to a refractor.

Turning to Saturn, I saw there were two belts on the globe, the northern one being widest and shortest. Concerning this planet, will the rings be more open next year? as, after looking at a sketch by "F.R.A.S." in "E. M." for 1870, I despair of seeing Cassini's division so open near the poles of the planet as those depicted, unless it will be so. Respecting the reflector, I find that the out-of-focus discs seen with H-eyepiece are of different colours round the edges, the one away from the focus being bluish, and the one inside the focus orange. I put this down to the chromatic aberrations of the eyepiece, and suggest that it may be a means of testing any ocular for colour. Would "F.R.A.S." or others kindly answer the following:—Should a mirror or o.g., perfectly corrected for figure, show the disturbances of the atmosphere, smoke, &c., more on the inside of the focus than the outside? I ask this because, on testing my mirror on good nights, the ring systems each side the focus are alike; but the moment smoke, heated air, or bad atmosphere comes on, the rings inside appear to suffer most, the central spot swaying from side to side, and the rings keeping anything but circular or distinct.

On a good night lately I saw Epsilon Arietis beautifully divided, and could see the division nicely with 4in. stop. Afterwards tried Zeta Cancri, and at times could certainly see them divided, the smaller component being to the right. The two small discs of Sigma 2 Cancri being very nicely seen as well. With 3¼ Wray o.g., I never could see the small star following the Ring

Nebula in Lyra, but on Nov. 17, 1883, I saw it quite easily with the reflector, and also the Debilissima pair of Epsilon Lyræ very much easier than with [illegible]; but, on the other hand, the blue [illegible] of Kappa Geminorum I cannot see so well. This seems [illegible], but I think it is owing to the colour of the [illegible], which makes it less visible; though why it should be more difficult with more light in the reflector than with less light of the refractor, I cannot say. I may say, in conclusion, that star discs and rings appear as sharp and hard as with [illegible] first-class [illegible], which is very different to what I expected when I ventured to make the exchange from one to the other.

Walsall, Feb. 25. **F. T.**

ASCERTAINING THE MOON'S AGE ON ANY DAY OF ANY MONTH.

[22402.]—Your correspondent, Major Trusswether, reminds me of a schoolboy who, when he cannot make his sum in arithmetic give the correct answer, concludes that there must be some error in the rule by which it is governed. As you have inserted his unfounded objection, will you kindly make room for the correct solution:

Question.—What is the moon's age on Jan. 1, 1884?

Here January is to be taken as the 11th month of the year preceding, reckoned from March. Also, 1883, divided by 19, gives remainder 2, and this, multiplied by 11, gives 22.

Hence we have	22
The third part of the century	6
The fourth	4
The number of months from March	11
The day of the month	1
The number	8
	52
Subtract the century	18
	34

or, rejecting multiples of 30, 4. Hence, the moon was four days old.

P.S.—The error by this method may amount to one day or two days at most, arising from the fact that the moon of the calendar is not the actual moon of the heavens. In this case, for example, there is an error of a day.

James Pearson, M.A., F.R.A.S.

Vicarage, Fleetwood, Feb. 22.

GRINDING EYEPIECE LENSES—DIALYTE TELESCOPES.

[22405.]—Your querist will find that the lens will not come up spherical if it revolves in the lathe; the lens should be held in the hand by its holder or stick; it should be worked against and with the motion of the lathe alternately. It is an advantage to the operator, whose experience is limited, to have a sunken tool, say one-fifth the diameter of the tool at its widest part; this should be in the centre of the tool. A polisher of best quality sealing-wax, in which a small quantity of rouge has been mixed while melted, will be found good. This should be stuck upon a metal chuck and turned carefully to the gauge. Washed rouge or putty powder and water should be used to polish with.

Mr Capleton's [illegible] glass should make [illegible] lenses. The rotary [illegible], all considered, is the best. The edging is almost complete, and of course the disc is more valuable; there is very little risk. Power is wanted certainly. [illegible] say any glass-works where steam power is used would undertake the job reasonably.

Our friend Mr. [illegible] has not, of course, noted the following practical facts when he suggested [illegible] as a reasonable figure for a [illegible] set of dialyte lenses. [illegible] should be of good figure. Now nearly all plate glass gives [illegible] images if worked true. I am of opinion this is owing to the pressure in making [illegible]. The surface then must be figured to counteract this, or I suggest [illegible] in the direction, so that the axes may be crossed. Lenses in the shape can be made cheap enough, but I think the form deserves the best that can be got. These will not be obtained for the price named.

Prismatique.

LATHE SCREWS—"UNLIMITED LIABILITY LATHE."

[22406.]—Your correspondent "H. [illegible] M." (letter [illegible]) remarks that he has heard nothing lately of the progress of the inquiry undertaken by the Amateur Mechanical Society in reference to lathe screws—I prefer this description of what is proposed to his own—and asks "What stops the way?" To this question I am sorry to reply that the witnesses themselves are the persons in fault—that is to say, that until I get about [illegible] answers to the interrogatories [illegible] I do not think the council would consider that they have sufficient evidence before them to warrant a decision. I hope you will allow me to take this opportunity of appealing to those members of the A.M.S. who have not yet sent in their answers to do so with as little delay as possible, and to say that if in any case the questions have been lost or mislaid, I shall be happy to send another copy on hearing to that effect.

I should like, whilst I have my pen in hand, to make an observation on the paper in your issue of February 15th, entitled an "Unlimited Liability Lathe." The writer has, no doubt, tried the plan he suggests for turning large work, such as a table top. I have not; but, seeing that the gouge would have to be held almost at arm's length for a great part of its traverse, and that the surface to be turned would be twice its usual height from the lathe bed, I should imagine it to be a work of extreme difficulty, if not impossibility, to produce a smooth and level surface, plank way of the wood, in such a position. To work a moulding on the edge would, of course, present less difficulty; but even for that I should prefer the alternative method of allowing the work to overhang the lathe-bed, which, in the case of a traversing mandrel especially, would not be difficult to arrange.

If an amateur is content to limit the size of his work, so that its semi-diameter shall not exceed the height of centre of his lathe by much more than three inches, he will find no better plan than the employment of lifting blocks, which may be of wood, to raise his lathe-head. My own, which are of cast iron, planed up true on all sides, measure 8½in. by 3in. by 1½in., and with them I can raise the centre of a 5in. lathe to 6½ or 8in., according as they lie on their edges or flat on the bearers, thus enabling me to turn up to nearly 16in. in diameter. I use with them a larger and higher tee-rest, and an extra long holding-down bolt: the former I had made, and for the latter I remember using a piece of iron rod on which I cut the necessary screws with a chasing tool that fitted the thread of the original bolt. That was, however, some twenty odd years ago, in what Mr. Burnaby would call the "pre-aliquot period," when, sad to say, we never troubled our heads about the precise pitch of the screws used for such purposes, and yet did some tolerable work! A pair of iron blocks, such as I have described, are useful for a variety of purposes besides that named above: they serve as weights; laid on a piece of glass paper spread upon the bench, I use them as rectangular guides for rubbing down the edges of small cabinetwork; and heated, they act as cauls for veneering small flat work. I fancy the amateur who follows Mr. Lukin's design, and puts his tray on the top of a pedestal 12in. high, will find that he has produced a very uncouth piece of furniture. I have a "dumb waiter," such as he intends to describe, made of some kind of ware, in which the underside of the 15in. plateau is only raised 3in. from the table. It answers its purpose and looks well.

T. W. Boord.

14, Berkeley-square, Feb. 19th, 1884.

[22407.]—The supposed difficulty does not exist. I can and have turned with ease a 15in. disc on my own [illegible] lathe in a vertical position by reversing the headstock, rigging up a high rest from the floor, and, of course, running the lathe backwards (or you will unscrew the chuck). I have used the fastest speed but one, and it quite suffices; and with the next or the very slowest speed I could turn 15in. without difficulty. But you want for this someone to tread for you, as you should be on the wrong side of the lathe, though I have managed it alone. To do away with this awkwardness I proposed the horizontal arrangement. If I drew the cord wrong, or the chuck was put on eccentrically, I did not intend it. The general notion was, I think, quite clear. A big disc acts partly as its own flywheel. No [illegible] of lathe is needed, only a screwed hole in poppet. It is no mare's nest—a pin in the rest, such as brassturners use, will no doubt make it easier to steady the tool. My 5in. lathe bed is gone for some fittings to be made, but as soon as it returns I shall use it as stated. If a disc can be turned of the size named, when running in a vertical plane, it will do just as well the other way. My flywheel has three speeds on the rim, and one for still slower motion. It is not specially heavy, but runs well on a stud. Ordinary [illegible] work is easy, and will be still easier, as I am having a new hand mandrel and collar fitted. My usual mode of cutting out a round disc is to put a square piece of board in the lathe with corners sawn off unless it is a small piece, and then to bring a sharp parting tool against its face, just within the largest possible circle. The outside rough part then comes off as a ring, and the edge of the disc is also tolerably smooth. This does away with the [illegible] of roughing down projections. The outer part left [illegible] may come in for beehive boards, which I make in that way, of mahogany, using the [illegible] for other purposes.

I am not at all sure that I shall not have a special short poppet made to stand on end, with [illegible] to fit the chucks, and a single-speed pulley. I [illegible] all arms to [illegible] to take the [illegible] [illegible]. This would improve matters, and save removal of the headstock, but it is the principle of a horizontal lathe for large discs which I specially wished to suggest. Observe that an 18in. disc only projects 9in., so that you are not obliged to stand back much further than usual.

O. J. L.

THE UNRELIABILITY LATHE.

[22403.]—No wonder W. A. Barber utters a mild protest against the utterly unpractical suggestions contained in the article he alludes to. It is characteristic of the author, and highly instructive to be taught the value of the ready "Yes," which the confiding inquirer receives, before he is started on the best road to "*How not to do it.*"

The points "W. A. B." refers to are quite beneath the notice of a "practical mind"! I do rather think it would take a 3in. head to turn a 2ft. table-top pretty evenly in every single part. First, we have the band on the largest speed of driving-wheel to smallest on mandrel. Those who have ever turned a 10in. to 12in. bread platter can form some idea as to the ease of doing it even on a 5in. lathe with the speed by no means at the highest. What will it be on a 3in., at edge of a 2ft. circle!

Next, we have the mandrel-head, whose frame is specially designed to give the greatest stability when axis is horizontal, cocked up on its end, held by a single bolt—in what must be a very shaky manner, even supposing there is the special bracket fitted to it. On top of this card castle we have our work fixed—probably at a height of 9in. to 12in. from the bed—and we ask the afflicted lathe to do its work to our satisfaction.

It must, too, be remembered, to make insecurity doubly insecure, the tool is to be supported on a rest which must rise more than the 10in. or 12in. above bed, and yet has only a 1½in. or 2in. socket to steady it.

If there are none of these self-evident defects in the plan, the need for guide-pulleys, and the amount of extra power absorbed in leading a band as shown, would be enough to condemn it for such a purpose.

And what is all this "much ado about nothing" when you get beyond desire to produce something novel? *There is nothing.* The work specified could be done in the old-fashioned way by turning the head, and rigging up a very simple rest, the back of a kitchen chair has more than once served such a purpose, and done its work well, which is more than could be said of this troublesome, and I imagine, completely unsatisfactory fixture.

Fredk. Carre.

BEE-KEEPING.

[22404.]—The bee-feeder mentioned by J. Perry, letter 22371, is a good one for rapid feeding, but not near so good as a bottle feeder, if well arranged and managed. I have used both very extensively, and much prefer the bottle with a graduated perforated cap [illegible] wood block, with slit [illegible] for regulating the quantity to be taken, with which I have no difficulty in either giving one hole very slow or eight to ten holes for rapid feeding.

I will now give my objection to the feeder mentioned, which is known as the float feeder. When new it works well for a time; but the syrup causes the float to warp or swell, when it catches either against the hole or sides, and sticks either up on one side or else when down, and in pouring fresh syrup in it goes [illegible], instead of [illegible] through it sinking, and if the bees are in at the time they get drowned, or stick together, causing a loss of bees, and if not to ease it, the bees get under the float, and get served the same.

I believe J. Perry and "[illegible] H." are like many others—they have read and studied "leaflet and bee-books," but when putting the [illegible] of some of the best bee masters into practice, are not sufficiently careful to attend to the [illegible], and thus fail and lay the blame on the wrong shoulders.

I was glad to see Mr. Abbott's letter, and wish he would contribute an article or two this spring. It could not be done by a more practical or better person, and I should be very glad to give place to him or any other such authority.

It might interest "[illegible] H." to know that the only bee-book I use is "Modern Bee-keeping," and I got more useful information from the "Leaflets" [illegible] that my plan was to read them carefully, then follow their teachings in all points, and by so doing I gained experience through practice.

I should have referred "[illegible] H." to them, only for what he said about them, and because I have often recommended them through the "E.M.," and do not like to be always pushing them before your readers; but the information I gave is quite clearly stated in them.

I shall be glad, as far as I can, to answer any queries of general interest during the coming year.

There is no mistake in the word [illegible]. I say [illegible], because I cannot get [illegible], and I do not think there is any necessity for thinner where wide [illegible], with [illegible] between. I put [illegible] and have the [illegible] across the entrance.

Movable bottoms are not required when you have plenty of length so as to move bars about for cleaning floorboard, &c.

I have hives with double walls all round, and double and movable wedged floorboards, in use; but think the others quite as good: they are all my own make. I think the South of Ireland a good place for bees, and hope "G. J. H." will succeed well this year; but much depends on the season as well as the *hives*, for if we do not get honey-producing weather no kind of hives will do well.

I have never tried the Ligurians; there seems to be such a difference of opinion amongst bee-masters as to their value, and only being a poor man I do not keep bees for pleasure only, but for profit. A friend of mine near here bought and introduced a queen, but did not succeed well with them; but I cannot say, having had nothing but the British Blacks. I have often raised queens, introduced them, both by grafting queen cells, and also, when mature, have transferred, deprived, united, divided, driven, rescued and built up condemned bees into good, useful stocks, and many other operations connected with modern bee-keeping, and, around here am called the beeman.

J. I. S.

BEE-KEEPING—FEEDERS.

[22405.]—The feeder mentioned by Mr. Perry is, I believe, very good for feeding up for winter, at least one on the same principle; but square and larger is first-rate for the purpose, as I have found by experience; but I do not know if it will answer well for stimulative feeding. If Mr. Perry means by "the bottle plan of feeding,"—turning a bottle of syrup upside-down on a piece of tin, and then slipping it on to a piece of perforated zinc over the feed-hole, I like it quite as little as he does; but there is another plan of bottle-feeder which, I think, by far the best for stimulative feeding, and I will describe how to make it. Get a large-mouthed bottle (I use marmalade bottles); make a tin cover like the cover of a canister, to fit it closely; mark a circle round the cover a little way inside the neck of the bottle; make a number of holes, say, 10 to 12 at equal distances on half the circumference of this circle. Get two square pieces of thin wood, say, ⅜in. thick, and make a round hole in them into which the cover of the bottle will fit, so as to turn round easily; get a piece of tin a little larger than the cover of the bottle, mark a circle on it of exactly the same radius as that marked on the cover; make the same number of holes on half the circumference at equal distances, which will be at exactly the same distances as those in the cover; put this piece of tin between the two pieces of wood, and tack them firmly together, taking care that the circle on the tin is exactly concentric with the holes in the timber. Now, on putting the neck of the bottle with the cover on it into the hole in the timber, you can in the first instance place it so that no hole in the cover will be opposite to one in the stage; you can now turn it round a little and bring one hole of each together, turn a little further and you will have two holes open, and so on till you have any number you like. Now, by making radial marks on the timber of the stage exactly opposite the holes in the tin and numbering them, and by fixing a little pointer or index opposite the first hole in the cover, you can manage so as to see at a glance how many holes are open, and increase or diminish the number as you think fit. The hole in the underneath piece of wood may be a little larger than that in the upper one, which fits the cover of the bottle, and the holes in the tin in the stage may be larger than those in the cover of the bottle.

I have described a rough home-made article, just as it was made by my son; but I cannot conceive anything more efficient for the purpose of stimulative feeding, or more easily managed. If Mr. Perry cannot make it himself, there is a feeder on the same plan known as "Green's Feeder," and also "Neighbour's Stimulating Feeder," sold by dealers in such things. I have used both kinds of feeders, and shall continue to use both. I would not think of using the bottle feeder for feeding up in autumn, and just as little would I think of using the float feeder for stimulative feeding; but I do not say that it could not be done, for I don't know, having never tried. I can speak from experience about feeders, as I had a great deal of feeding to do, most of my stocks being formed of "condemned bees," driven late in September without any comb or brood to transfer, and the remainder being swarms which required a good deal of feeding in the bad weather we had last summer, and nothing could have been more successful. My bees are out every day that is at all fine, and are now taking in pollen from crocuses, as well as from some other sources—I dare say furze. I first saw it with them on the 17th February.

G. J. H.

Erratum (letter 22372).—I find that the mode of Ligurianising mentioned by me at end of letter 22372, p. 536, is not taken from Mr. Raynor's pamphlet, but from "Abbott's Leaflets," No. 3, on Ligurianising.—G. J. H.

[22406.]—Several correspondents have asked lately for information about bee-keeping on the bar-frame system. I have tried this plan, and will give the results obtained. I must first state that I was very much prejudiced in favour of this plan. I determined to commence on the smallest scale, so in the early part of 1882 I procured Mr. John Hunter's "Manual of Bee-keeping," and thoroughly studied it. I came to the conclusion that the cheapest hive with which this system could be effectually worked was Neighbour's "Modern Garden Hive," so I ordered one, price 25s., besides carriage from London, which with 2lb. of "comb foundation" and "smoker," made the sum of 37s. I then bought an early swarm for 15s.; these, owing perhaps to an unfavourable season, produced no surplus honey. In the early spring I commenced to feed: they took two stones of sugar, cost 8s., tin for feeding 6d.; this makes a total for one hive of £3 0s. 6d. for the year, with as yet *no return*. This brings us to the spring of 1883; then my only necessary expense (I bought other things, such as a supply of American sections) was another hive, and the old stock having become strong through early feeding I divided them, as per instructions; this was successfully done; the bees worked when the weather was fine, and I anticipated a profit. The result was: no work done in the supers, and on examining the interiors of the hives, No. 1 was found with no honey to spare; No. 2 being pretty full, I took two bars, replacing with empty comb foundation. Yield of honey, 4lb.; value, 4s.

Here we have a return of 4s. for the outlay of as many pounds, besides time given at intervals over a period of a year and a half. Compare this with the glowing accounts of bee-keeping as given by some other writers. It will, I know, be said that the seasons have been exceptionally unfavourable. This I grant; and I retort that the very rosy pictures given on the other side are, as far as they are facts, quite as exceptional. Now, as to the hives themselves. They certainly cannot be called cheap: the price is at least enough to pay for good materials and workmanship; but do we always get these? During the fine weather, a short time ago, I thought it would be a good opportunity to see how the bees were going on. I found No. 2 all right—but No. 1! The faulty roof had opened at the joints, let the rain in, and—well—I have *one* stock of bees! The cover of No. 2 showed its quality earlier, and I had it pitched inside; otherwise I should probably have had no bees at all.

The above are the facts in my case. My opinion is, that *profitable* bee-keeping is impossible with anything like the original outlay at present necessary for the bar-frame system. Those who reap the profits are the dealers in the hives and apparatus.

I will, in another letter, give an account of a plan, though not yet tried, by which I believe straw skeps may be used, the bees not killed, and the bee-keeper paid for his outlay and trouble.

W. A. G.

[22407.]—I am glad to find that the correspondence on bee-keeping is reviving, and with "G. J. H." I hope we shall have the results of "real practical experience," whether it be amateur or professional. Bee books, though exceedingly useful and necessary, often fall short of what the would-be bee-keeper expects to find them. I have read several, but some of their statements I cannot accept. For instance—what weight of store will "winter" a stock? Now I have had the experience of many years among skeps, though only since last year among frame hives, and I have found that when a skep and contents weighed 21lb., the bees in it wintered well, and put out a good and early swarm. And even on less than this I should have little fear of their having plenty to carry them well into the ensuing spring, unless exceedingly mild weather in January and February causes them to fly when they ought to be at rest.

I well remember, some dozen or more years ago, an exceedingly good honey harvest. Nearly every hive was full, and consequently some much heavier hives than usual were left as permanent stocks for the next year. One of these, a very heavy one, having a numerous colony of bees, was expected to do well, but, on the contrary, it proved the worst in the lot. The bees having plenty of stores, were careless about gathering more, and spring being over, the summer was cold and wet, preventing their doing much when the store was exhausted. Hence, the colony proved really worthless. Now, I am far from saying that excess of stores was alone the cause of this; but, though I have since wintered some scores of skeps, I have taken care never to leave an abnormally heavy one. Better, far better, have too much than too little; better still, have no more than is necessary.

Orderic Vital.

BEES.—SPRING TREATMENT, &c.

[22408.]—Knowing that many stocks of bees in this country are now, owing to the mildness of the weather, breeding rapidly, I wish as a bee-keeper to give a few hints that I feel sure bee-keeping readers of "E. M." will not regret giving their attention to:—

1. Make it a rule early every spring and every autumn (on as mild days as possible) to make a quick and thorough examination of all your hives; clean their floorboards with a knife, and with a stiff brush brush all your hives clean and destroy all insect enemies, such as spiders, moth, earwigs, woodlice, &c., that may be found on or near them. Do not expose your hives to the air longer than you can help during the examination, &c., or you may chill the brood.

2. Feed such stocks as you find really need it, and take especial care of such as you find have a small number of bees in them, remembering that such stocks will find it hard to keep their hive up to the right heat for breeding, &c., and should therefore have their entrances made smaller and extra covering put on. Keep a sharp look-out for queen wasps, and destroy all you can find.

3. In a mild winter like the present bees breed more than in cold ones, therefore care should be taken not to have their entrances too large, and that they have sufficient covering on to prevent the brood in them from becoming chilled should the present mild weather be followed by a very cold spring. Remember that hives that are breeeding consume their stores rapidly, and although breeding ought not to be encouraged too soon, for fear of a return of winterly weather, care must be taken not to let your bees and brood die for want of food. Should their stores be small, they must be fed moderately.

4. In feeding your stocks in early spring, do so if possible on a warm day; if a cold cutting wind is blowing, such bees as are sure to be tempted out by your feeding will be chilled, and fall to the ground and perish. Avoid spilling food whilst feeding; it causes robbing if spilt.

5. Beware of dampness; keep your hives as dry as possible. I have an idea that a wet hive in company with a chilled brood has often helped greatly, if it has not really produced, foul brood, &c. Food given (in mild weather especially) greatly encourages breeding.

5. After you feel sure the winter has gone (and not before) encourage your bees to breed as much as possible; but always be on your guard against a spell of cold weather, and know that your best protectors are a small entrance and extra coverings. Small entrances are a good prevention of robbing.

7. Keep your stocks strong; use large hives, and put strong swarms in them; unite your swarms if they are weak; do everything to your bees in as quiet a manner as possible. Remember June is the month if you want honey, and as a last warning I would say should a cold spring follow the present mild weather, I hope such as have taken the hints I have endeavoured to give will not regret it when summer comes, and be none the worse for having heard the timely buzz of **A Working Bee.**

ELECTRICITY A MECHANICAL VIBRATION.

[22409.]—In letter 22305, p. 473, it was shown that when water and carbonic acid were produced by combustion, chemical affinity was an expansive force. Now chemical action also causes an expansion in the combustion of iron or zinc with oxygen, for the oxides of iron and zinc are less dense than the metals, and although the alteration in bulk is very little, yet the force required to produce it is in comparison very great, whether estimated by the heat obtained during the change from metal to oxide, or by the cohesion which is overcome. But there is a movement of oxygen as well as metal, and the oxygen must of necessity move faster than the metal, because it condenses from a gas to a solid, while the metal remains a solid, and almost without motion; and having regard to the combining weight, the momentum of the slow movement of the zinc will be overcome by the rapid movement of the oxygen, which will therefore give the most powerful mechanical effect. Again, when oxygen unites with hydrogen it moves into double its ordinary bulk, while the volume of hydrogen remains constant, so that in this case, as well, the oxygen is still the moving and consequently active mechanical agent. Also, E. Becquerel has determined by experiment that the amount of oxygen or of a similar substance, and not the metal, determines the amount of electricity in the galvanic action. The action of a battery may, therefore, be explained as follows:—If the liquid in a voltaic cell be vibrating each time a condensing vibration occurs, the oxygen will leave the hydrogen and combine with the zinc: this action will check the vibrations of the liquid, and produce a vibration in the zinc which will tend to expand in all directions, and traverse substances suited to its nature. The liquid, on the other hand, will absorb a vibratory force equal to what it has lost by the oxygen combining with the zinc. If the liquid is heated, then, because heat is a vibratory force, the vibrations become more rapid or powerful, or of greater number, and the action of the battery is therefore increased, which is known to be the case experimentally.

I consider this view of the battery is supported by the following circumstances:—

Water and some other liquids are mechanically carried through nonconducting porous substances by galvanic action, and when water is mechanically forced through such substances, galvanic action is produced; mechanical force and galvanic action are therefore directly convertible.

The stratified form of the electric light in vacuum tubes is an effect similar to the nodal points in the vibrations of sound. The passage of the current of a powerful secondary battery can produce both sounds and nodal points in an ignited platinum wire.

Priestley also noticed a difference in the tone of leyden jars when discharging, which he attributed to the surface of the jars, as well as the amount of charge, so that electricity has been connected with sound long before the present time.

J. Sutcliffe.

ELECTRO-MAGNETS.

[22410.]—"SIGMA" (23342, p. 519), asserts as I understand, that a magnet which is supporting a weight is doing more work than one which is not supporting any weight.

Let "Sigma" try the following experiment. Let him take an ordinary horse-shoe steel magnet; let him put on the armature, and hang a weight from it. He will find that the magnet, if undisturbed, will support the weight for an indefinite time. In the case of an electro-magnet, "Sigma" believes "that there would be a permanent reduction" in the strength of the current, thus showing that energy is consumed in merely supporting a weight. In the case of the permanent steel magnet, what is the source of the energy which enables the magnet to support the weight?

As a matter of fact, there is no greater cohesion between a magnet and its armature when a weight, such as the magnet is capable of supporting, is hung on the armature, than there is when no weight is hung on the armature. The analogy from animal muscles is entirely misleading. If fatigue is evidence of work done, the traveller in a railway carriage, and hosts of other people who get tired without doing anything, must get through an immense amount of work.

No doubt, if "Sigma" moves masses of iron in the vicinity of magnets, work is done, and the effect of this will be apparent on the galvanometer.

Prof. Sylvanus Thompson showed a very elegant experiment illustrating this in one of his Cantor lectures. A small electro-motor was connected in series with a battery and the lecturer's lantern galvanometer by means of which the deflection is visible to the whole audience. When the motor was allowed to rotate the deflection was less than when the pulley of the motor was held, thus indicating that a back E.M.F. was produced, and work done by the motor as "Sigma" has explained.

Should "X. N. X." try any delicate experiment with a Wheatstone bridge, he must be careful not to use an iron weight, whose movement in the neighbourhood of an electro-magnet might possibly induce currents, but a weight of wood or some other non-conductor. He will then find no indication of any increased work. He may, however, be quite satisfied with the result of his experiment described on p. 473.

Pem.

[22411.]—MY electro-magnet is one with thick wire, which, when excited by a good Daniell cell of large size, has held 56lb; but as the cell I employed in my experiment, described on p. 473 was not a very strong one, I used a 28lb. weight only.

There was a momentary reduction of current at the instant of bringing up the keeper and weight to the magnet: but as soon as the keeper is at rest sustained by the magnets, the current resumes its original intensity. There is, indeed, no reason to anticipate any (permanent) reduction of current since the magnet holding the weight is not doing work. Work is only done by the current while the keeper is in motion, since work implies overcoming resistance through a certain distance. While the keeper is in motion towards the magnet the current is reduced, in consequence of the inverse electromotive force generated by its motion, as in a magneto-electric machine or dynamo. This is more easily shown experimentally by the use of a small electromotor, and, as the experiment is an easy one, let me advise those of your readers who are in doubt upon these fundamental points, to try it for themselves. I worked my motor by a battery of five Grove's cells, through a tangent galvanometer, the galvanometer and battery being at one end of the room and the electromotor at the other. If the electromotor was held so as to prevent it doing work, the deflection was about 45°, but if allowed to revolve and do work an immediate reduction of current took place, and the faster the motor revolved the smaller was the current. Thus when running slowly the deflection was 40° (current about ¾ of original current), and when allowed to run at full speed the deflection was only 28°, or the current about half of what it was at first.

I supposed that the error to which I called attention was merely the result of haste in writing: but it appears from "Sigma's" letter that he believes there will be a permanent reduction of current, and that he really means that a table on which a weight rests is doing work. The case of fatigue produced by muscular exertion in holding up a weight (though it might suggest an interesting physiological problem) is here a misleading analogy. Fatigue is caused, but not because mechanical work is done by a mere act of sustaining the weight: the weight must be raised in order to do work.

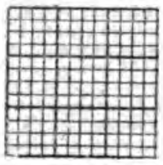
X. N. X.

MICROSCOPIC TEST OBJECTS.

[22412.]—I AM glad to see that "Monachus" (letter 23337) has stated this question in its simplest form, thereby bringing it within the limits of argument.

The proof by Prof. Abbe, that in order to be able to see a grating the dioptric and one first diffraction spectrum must be taken up by the objective, is also a proof that it is unnecessary to pick up all the diffraction spectra to see it.

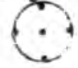
Let us imagine squares, strongly ruled on glass



12,500 per inch (linear), and inside each of these squares sixteen faintly-ruled squares.

An objective, N.A. 26, with axial illumination,

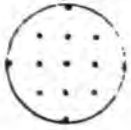
Fig. 1.



would show diffraction spectra, as in Fig. 1; the strongly-ruled squares would only be resolved.

Fig. 2 represents the diffraction spectra seen by an

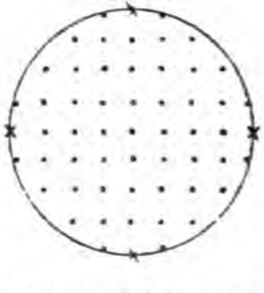
Fig. 2.



aperture of N.A. 52, the strong squares above being resolved. Fig. 3, aperture N.A. 1·04. The faint squares are now seen.

The spectra marked by a + are double ones, viz.

Fig. 3.



—the fourth order of the strong squares and the first order of the faint. Nothing further would be seen, even if the fourth order of the faint and the sixteenth order of the strong were admitted. Hence the true structure can be seen without taking up all the diffraction spectra, which, I infer, is the same thing as the "whole of the diffraction pencil," as stated by "Monachus."

The fact that various pictures may be produced by manipulating these spectra is not pertinent to this question, which differs from the original argument of axial versus oblique light, fully discussed in my last letter.

Having now stated all my view on this subject, I will not further trespass on your valuable space.

February 18th. **Edward M. Nelson.**

[22413.]—I AM glad that we have at last arrived at a point at which we can say Q.E.D.

Mr. Nelson in his first letter (22134) wrote: "If *S. gemma* is examined by this means, the true structure (which is far more beatiful) is revealed."

I invited Mr. Nelson (22151) to explain how he had come to recognise that with the objects of which he wrote there could be any determination of structure as "true."

Mr. Nelson replied at length (22203) with a statement of the reasons which had led him to realise the uselessness of oblique light "for the determination of true structure," and citing as an instance of such determination the appearance of places where chips had flown off the sides of a groove in glass.

I replied (No. 22261) pointing out the fallacy of Mr. Nelson's supposition that he had determined the true structure of his objects.

Mr. Nelson now says (No. 23336) that in writing of "true structure" he was not alluding to the "ultimate true" structure.

I have only two remarks to make on this.

The first is Q.E.D.

The second is that I hope our more advanced brethren will not overlook the moral of this correspondence, but will bear in mind how disturbing it is to our less advanced brethren to have incautious statements put forward which require so much hammering at to set right afterwards.

Monachus.

GLASS DISCS FOR REFLECTORS.

[22414.]—AFTER reading Mr. Wassell's excellent letters, in which he so carefully described his mode of producing reflectors, I am surprised that he is content to begin with the glass prepared in the manner he mentions. Surely if reflectors are worth all the trouble and care he appears to bestow on them, it would be wise to begin with a piece of glass as carefully prepared as possible. Now, if glass is nipped round the edge, it will be steened and strained more or less, which the most careful working afterwards would never get rid of.

"Nun. Dor.'s" directions for making the copper cylinders are quite correct. If they run true and firm, there will not be much difficulty in starting, and there is no reason why a dozen or more should not be going at the same time. One man would easily attend to the whole. I have used these saws for various purposes for 25 years, and can testify to the quality of the work. They should not be made air-tight. My experience is, that emery and water is best for stone, marble, or glass; oil and emery for metals.

Matlock. **W. Potter.**

CONCERNING LOCOMOTIVES — TO "HISTORIAN" AND MR. WOODWARD.

[22415.]—IT is not desirable to let this discussion degenerate into a mere squabble as to whether a certain expression was or was not a fair paraphrase of "Historian's" remarks, so we had best "agree to differ" on the subject. It would, I think, be very interesting if he would give tabular details of certain engines, *accompanied by distinct statements as to their actual performance*, and including the water evaporated and fuel consumed. As to the h.p. of engines, we seem to have pretty much arrived at the conclusion that the calculation I made on p. 386 was correct; but that it is not usual to express the power of engines in this way. I have to thank some gentleman who sent to me, apropos to a passage in letter 23344, a pamphlet concerning the claims of Mr. Hedley, as inventor of the locomotive. I am much obliged to Mr. Woodward for pointing out that one of the problems in query 52862 was set with impossible data: it certainly escaped my notice. I wonder if it was done purposely, or is a slip? There was a glaring error in the advanced paper for "Applied Mechanics," last May.

Wm. John Grey.

Elswick Science School.

[22416.]—I HAVE read the discussion on the horse-power of locomotives with much interest and my views coincide with those of your able correspondents, Mr. C. E. Stretton and "Historian." I can indorse the formula given by your correspondents as correct—viz.:—

$$R = 2 - \frac{V^2}{114} \text{ pounds per ton.}$$

If S = space passed over per minute in feet,

$$\text{Horse-power} = \frac{W.R.S.}{33,000}$$

W = total weight of the train in tons.

The above is, of course, information which has been supplied by Mr. Luis. But Mr. Grey will see that the above involves no elements which are connected with the dimensions of the engine pulling the train. It is here that the "uncertainty" comes in.

Perhaps Mr. Grey will understand this uncertainty better if I tell him that it is probable that no two engines built from the same drawings will run alike.

Perhaps I may make this clearer by quoting a passage from one of Mr. Reynolds' books:—

difference cannot, of course, be attributed to the drawings or the templates from which the engines were made. It is, for the most part, due to the putting of the parts of the engines together; for no two engines were ever put together geometrically alike; and even when they are very nearly identical in the erection, they may be, and have been, made very unlike by so simple a matter as the construction of the brick arch in the firebox. Arches may be too long, too short, too high, or too low. They may also be rendered unlike by following slightly different lines in cementing the smokebox—probably the most sensitive member about a locomotive engine. There are many other ways of explaining why a difference should exist between sister engines. It may be in the castings of the cylinders, in the copper of the firebox, in the valves, or in the chimney."

Again, although the boiler pressure of two engines may be the same, yet the effective pressure in the cylinders may be slightly different. This will, of course, alter the power which the engines are capable of exerting. The pressure in the cylinders cannot be calculated from the boiler pressure. It can only be approximated. For instance, with a boiler pressure of 140lb., the pressure in the cylinders will be about 95lb.; but the exact pressure is a matter to be determined by experiments made with the indicator. Again, one class of engines will exert more power and run better than another class, of practically the same dimensions, because they "steam" better, or run more freely.

I think Mr. Grey will understand, from the above instances, that there is a very large amount of uncertainty as to the power which will be exerted by an engine of any given design. It is, in fact, a matter entirely for experiment to decide if engines of a given design will work the traffic they are designed for. It is for these reasons that the power of a loco. is estimated in tractive force.

The formula used, which shows results coinciding with the results of experiment, is—

$$\frac{(\text{Dia. of cyl.})^2 \times \text{stroke}}{\text{dia. of driving wheel}}, \text{ all in inches.}$$

This gives the tractive force in pounds per lb. per sq. inch effective pressure in the cylinders.

It has been found by experiment that to attain a velocity of 60 miles per hour on a level, with 15 coaches (or say 150 tons, exclusive of engine and tender), requires a T.F. of 100lb. per lb. effective pressure in the cylinders. This has often been pointed out by Mr. Stretton. Mr. Grey might connect horse-power and T.F. by finding the work done in moving such a load at 60 miles per hour on the level from the formula given at the beginning of this letter; but although theoretically interesting, I am afraid the result would prove of but little value.

On looking over the earlier letters of this correspondence, I find an inquiry from Mr. Grey as to the speed that can be obtained from driving wheels of a certain size. I may add that the least dia. of driving wheel which I have known to run at 60 miles per hour is 5ft. 3in. (L.C. and D. and M.R. tank engines). On the L. and N.W.R. a 6-coupled goods engine (with the side rods connecting leading and driving wheels taken off), with 5ft. 2in. wheels, could only attain a speed of 59 miles per hour, owing, it is stated, to the wheels being too small to attain 60.

Meteor.

RAILWAY KEYS.

[22417.]—The recent decision of the Midland Railway Company to place the keys on the outside of the rails instead of the inside as at present, has called attention to the whole question of permanent way, and promoted considerable discussion in engineering circles. The advocates of the inside and outside systems appear to have been very equally divided, and very powerful arguments have been brought forward upon each side. The question is constantly asked: "What is the reason for the present change?" Your correspondent "Loco," p. 524, No. 52979, has endeavoured to find a cause, and states it is "*so that wheels will run longer without turning up.*" It is hardly necessary for me to tell your readers that such a reply is absurd, and does not throw any light upon the matter.

Previously to the year 1870 the Midland Company had adopted the usual plan of placing the keys *outside* the rails; at that time it was found that the keys so placed came out of the chairs to a serious and dangerous extent. On some occasions three and even four consecutive keys were found out of the chairs, the result being that there was nothing to prevent the train from "spreading the road" to a dangerous amount, and cases did occur of vehicles leaving the line in consequence. The company, therefore, in 1870-71 considered that the *inside* position was to be preferred, as if the keys should come out there would be no danger, as the gauge of the line was maintained by the outer jaw of the chair, and not by the key. It was also considered that platelayers would more conveniently examine their lengths of permanent way when they could see the keys of both rails at one time.

The *inside* keys gave general satisfaction for several years, and there was no doubt that the system made a good strong road; the question is whether it was not too strong—amounting to rigidity, for since the weight of engines and rolling stock has increased, the number of broken chairs has become a serious matter for consideration.

Complaints have for a long time been made that Midland trains appear to run "harder" and more "noisily" than those of some other lines. One cause of "noise" is doubtless to be found in the ballasting.

Your readers will have observed that upon many railways the sleepers and the bottom side of the rails are covered with ballast; this tends very materially to insure quieter running; but, on the other hand in rainy seasons it keeps the permanent way in a wet state unless very well drained. The Midland Company adopted the plan of never allowing the ballast to cover the sleepers, thus insuring a dry road, but at the same time a noisy one.

This Company has, therefore, decided upon the report of its new engineer (Mr. Langley), to place the keys on the *outside*, considering that the introduction of wood between the rail and chair will provide the necessary elasticity which is so evidently required to prevent the continual breakage of chairs. The level of the ballast is also to be raised, with a view to reduce noise.

Experiments are now being made to obtain some really good system of preventing keys working out of the chairs. Several plans are being practically tested upon parts of road with the heaviest traffic. So far the best results are given by chairs which are "roughed" or have teeth on the inner side of the jaw; it is, therefore, probable that this pattern will be adopted.

In shunting yards and sidings the ballast should always be raised (both between the rails and in the six-foot way) to the level of, or very little below, the top of the rail. Many guards and shunters are annually killed and injured by catching their feet against the top of the rail when stepping under the buffers of waggons, either to couple or uncouple them, and, of course, any slip made at such a critical moment is almost certain to result in serious consequences, and as the raising of the ballast to the required level is such a very simple and inexpensive matter, it is to be hoped the companies will do all in their power to make shunting as safe as possible.

In conclusion, I may mention that I have a number of diagrams and details of permanent way (which form part of a paper read by me, and of my pamphlet on permanent way), some of which, I hope, at no very distant date, to place before the readers of the English Mechanic.

Clement E. Stretton, C.E.

Leicester, February 23.

ATTRACTION BY SOUND.

[22418.]—I recently made the experiment of the attraction of light substances, such as tissue paper and gold leaf by the vibrations of an ordinary steel tuning-fork, and after repeating the experiment frequently, the fork become less active, until, by degrees, it had no perceptible effect. When, however, the fork was heated red-hot and well hammered, the attractive quality was again restored, so that when struck, it acted on gold-leaf very powerfully, producing an appearance similar to the electric attraction. The best effect is obtained when the prongs of the fork are rather flat, and not too much space between them. The attraction is occasioned by a mechanical movement of the air. As at present the phenomena of sound is again being brought forward, those of your readers who wish to succeed in experiments with the sound radiometer, &c., must take care that the tuning-forks they employ are made as elastic as possible with the hammer. Filing or grinding is objectionable.

J. Sutcliffe.

JOSHUA AND THE SUN STANDING STILL.

[22419.]—A few months ago there was a long controversy in your columns on the alleged miracle of Joshua commanding the Sun to stand still. I do not wish to reopen the controversy, but merely to inform your readers that in *The Church Quarterly Review* for January, a new and very able explanation of the occurrence has been given. It goes to show that Joshua prayed that both sun and moon might be silent—i.e., cease to shine (*dôm shemesh* are the Hebrew words), because he found that the hailstones, and the consequent darkness of the terrible storm caused more harm to his foes than the spears of Israel: hence he prayed that the darkness might be continued until the Amorites were overcome.

This philological discovery, which is perfectly tenable, dispels at once the astronomical objections to the miracle that have been so often made, and will give comfort to minds that are often sorely exercised by Scriptural statements which through lack of knowledge they cannot explain. As I said, I merely wish to give this information concerning this article in *The Church Quarterly Review* to those who in your columns conducted a lengthened controversy—one that now admits of so simple an explanation.

A. C. Smith.

CLEPSYDRA, OR DRIVING CLOCK FOR SMALL TELESCOPES.

[22420.]—While looking over an old book the other day, I came across what I thought looked a very simple method of constructing that expensive yet indispensable thing, a driving clock. The parts are:—Fig. 1. A, metal cylinder, stout enough not to get dented; B, floating box, containing weight (about 2lb.); C, angle iron, soldered or riveted on to cylinder, with pulley; D, brass siphon tube, with two cocks; E, thread to telescope. The dimensions are as follows for a 3in. or 4in. telescope:—Large cylinder, 2ft. high, 6in. bore; brass siphon tube, about 52in. long. I have just constructed a clepsydra like this, and find it drives beautifully accurately my 3in. telescope. Mine is constructed of sheet lead, and the whole thing, including labour, cost me 10s. There should be two cocks on siphon tube, so that when the right flow of water has been ascertained by trial, one cock may be fixed, while the other is used for stopping or working the machine. There should be a winding drum on eye end of telescope, to allow for lengthening and shortening thread. This I manage thus:—In Fig. 2 A is a winding drum, fixed on to and revolving round sliding tube of telescope, and capable of being jammed by slightly pushing in sliding tube.

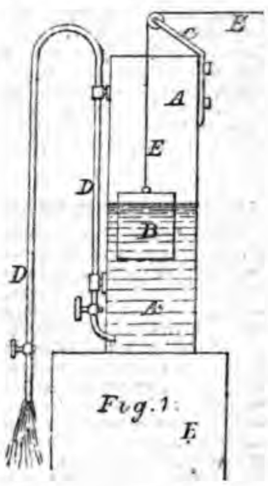


Fig. 1

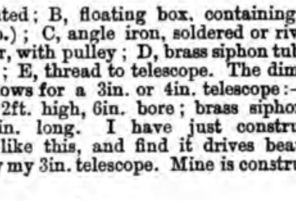


Fig 2

F. Hughes.

PUMPING BY SUCTION.

[22421.]—Though I did not dream that "Essar" either ignored or was ignorant of atmospheric pressure, yet his letter (p. 499) seemed to intimate the existence of some *additional* force at work; and this was why I used the phrase "as a *factor* in the working," &c.; am sorry I misunderstood him.

From the original note (p. 453) it seems plain that at or near the close of the upward stroke, the pressure of the atmosphere sustains the weight of a column of water 37ft. in height. It may be possible, but I should as soon expect to see that selfsame pressure supporting 33in. of mercury in the barometer. I should be as pleased as "Essar" to see it proved, and so shall wait to see what P. J. Davies may be good enough to tell us.

The pump so well described by "W. W. W." does not seem to have anything in common with the one mentioned p. 453.

"W. A. G." makes me describe "suction" as "a feat." The fact that he is unable to do the schoolboy task of reading correctly my letter, accounts for the illustration (the "baby") that so so naturally occurs to him.

Egstow.

GLACIERS.

[22422.]—Your able correspondent, "C. B. A.," in writing on the movements of glaciers, seems to me to have overlooked one most important factor—

viz., the internal heat or bottom warmth of the mountains. It is well known several important streams, such as the Rhone and the Rhine, are almost entirely fed by water running away from the glaciers. This melting of the ice of glaciers goes on strongest and quickest at their bottoms; in consequence, as the support of the superincumbent masses is taken away below and underneath, they must move. That this bottom warmth and consequent melting away of the glaciers is at least a certain cause of movement is shown also by the difference in movement during summer and winter. In summer, the glaciers, particularly in hot summers, draw "up," almost visibly, the mountains, through the rapid melting away; while in winter, the longer and harder the frost, the quicker and farther they advance "down" the mountains. It will be seen, therefore, that the movements of glaciers are not simply as "C. F. A." has it, "downwards," but "backwards" in summer and "forwards" in winter, so that heat, the melting and freezing of the snow particles, must play a most important part in their movements.

F. W. H.

INGROWING TOENAILS.

[[illegible].]—Have a pair of pepper nail-scissors, and instead of cutting your nails in the usual way, cut them hollow. Work your scissors points on the centre of the nail, finishing, as it were, a half-moon shape, leaving the corners standing nearly to a sharp point. Do this and follow it up as your nails grow, and you will find the sides will soon grow out and keep out. Bathe your feet in warm water, with a little soda in, before cutting your nails, as it will soften them so that you can cut them easier. The above has been a blessing to me now for several years, and I would not deviate from it for any amount of money, for prior to it I had tried everything which has been named by your correspondents, and a hundred things more fruitlessly. Nature always makes an effort to fill up a vacant space, that accounts for the success of the remedy.

Fisher Shaw.

[illegible], Stanton-street, Newcastle-on-Tyne.

KETTLE BROTH.

[[illegible].]—The following is a palatable dish much used in Germany for invalids. Stale bread broken into a pint basin about three parts full, a piece of butter the size of half an egg, plenty of pepper and salt; pour on boiling water enough to cover the whole; put a plate on the basin, and let it stand about [illegible] minutes or more. This will stay on the stomach when few other things will.

R. L. Caplan.

This is the "kettle broth" familiar to North Devonians and others in the West of England, where, however, the dish is made more luxurious by the substitution of clotted cream for butter. If it were better known in districts where milk is dear, or not to be obtained, many a hungry child might have a cheap, good breakfast.—Ed.

THE TELEPHONE.

[[illegible].]—It seems a very strange thing that in these times a company can so completely monopolise an invention like the telephone, in the face of so much evidence to prove that neither Professor Bell nor Edison can claim priority of invention any more in this country than in America.

I was much interested in reading two letters upon the validity of the United Telephone Co.'s patents, which appeared in the [illegible], Feb. [illegible].

The first letter is from a well-known authority upon this much-vexed question, W. C. Barney, whom I feel sure is known at least by name to most of our readers. He states, "In 18[illegible] the following description of a telephone receiver:—'An electro-magnet in front of a brass diaphragm, with an iron button attached to the centre of the diaphragm.' This description was published in England," he states, in the above year. He also says "that the original instrument is in the possession of a friend, and talks as well as any Bell telephone."

This invention, if it can be upheld, would undoubtedly nullify Bell's patent.

Next in the order another claim of priority to Edison's [illegible] from the same [illegible]. I am also strongly inclined to believe that evidence is in existence that in 18[illegible] a transmitter for telephone purposes, consisting of a tension regulator in combination with a diaphragm, was made and publicly exhibited, by means of which [illegible] was heard in a receiver and the difference between the speakers' voices [illegible].

This [illegible] a very strong evidence against the claims of the United [illegible] receiver invented [illegible] there must yet remain some description [illegible]

Turning again to the second claim of priority in the case of Edison's tension regulator, if the transmitter of 1865 is in existence, surely there can be no difficulty in its being identified by some of those who saw it publicly exhibited in that year.

It surprises me greatly that with such a mass of information no one dares dispute the claims of the Telephone Cos. here; perhaps the late decision in favour of Drawbaugh may add new life to the flagging energies of our enterprising electricians, for on turning to another letter from an old friend of ours, Mr. H. B. T. Strangways published in the same paper, some startling facts are again disclosed. He states, "The Court of Appeal decided that the exhibition of the Glasgow instrument was a publication of that instrument, which is consequently free to the public."

How is it that it is impossible to get any of these legal instruments? I have written to most of the electrical firms in England and Scotland, but no one seems to know anything about them.

Mr. Strangways also kindly informs us "That the Bell patent is good for a particular combination of parts of which that receiver is composed, which are:—

"1st. A permanent magnet, which one of the judges said was adjustable.

"2nd. A coil of wire on the end of the magnet next to the diaphragm.

"3rd. A diaphragm of iron, or steel, or metal capable of magnetic induction held down all round its circumference."

Now all these particular combinations can be done away with, leaving a perfectly legal instrument capable of transmitting speech.

1st. The magnet may be made of a solid bar of soft iron magnetised by a coil of wire and a battery.

2nd. The diaphragm can be made of wood, parchment, or any other non-magnetic substance, and under this diaphragm a thin sheet of spring steel may press. The steel will be moved by the vibrating of the diaphragm.

3rd. The bobbin of wire and the diaphragm may be placed at opposite ends of the magnet without in the least interfering with the acoustic properties of the instrument.

Perhaps it might not be uninteresting to some of your readers to know of a transmitter which I have made, and which I believe is covered by no patent: it consists of a Grove cell of 4in. high, 1½in. wide, and 8in. long. In the outer cell are two plates of zinc so arranged as to be lifted out of the acid when the telephone is hung on a hook; and a thin ferrotype plate has soldered to it a thin sheet of platinum which dips only a very little way into the acid.

The battery stands in a wooden box, the top of which is padded all round with rubber, upon which the ferrotype plate stands.

One wire is covered to the zinc, the other to the platinum, and I found that this instrument spoke well when connected with a Bell telephone.

Another transmitter I am now making consists of an induction coil wound in two separate parts: the fine wire is in one layer in the shape of a spiral, and is fixed to a diaphragm, the other wire is also in a spiral, and is brought very near to the fine wire, from which it is separated by a very thin rubber band.

This, if successful, ought to make a very compact instrument. I connect the coil in the usual way: secondary to battery, primary to line and earth.

I have not yet tried it, so cannot answer for its working well.

C. C. MacCarthy.

Late Electrician, American Telephone Co.,
Rotterdam.

PRINCE BISMARCK AND THE VEGETARIANS.

[[illegible].]—I AM rather curious to know how the vegetarian authorities "dispose of" Bismarck. Some twelve months ago, and often since, they have endeavoured to show, but in a way not always satisfactory to thoughtful readers, that a great variety of cases support their theories. Two or three instances will illustrate my meaning. Feb. [illegible], No. [illegible], p. [illegible], a whole school became docile under their regime. But so did Squeers's boys, who helped to immortalise Dickens. No. [illegible], p. [illegible], a wild girl found in a forest, bounded from branch to branch, &c., like a squirrel; by eating flesh she lost all this nimbleness. In short, in my view, she had begun a process of development into a higher type. To reverse the argument, had the vegetarians sent a girl into the forest to acquire this [illegible] kind of nimbleness, she would certainly have been a very good example of reversion to an earlier type. But nearly the whole of the cases in these two numbers of the English Mechanic have a [illegible] ring about them, and are little adapted to [illegible] people in civilised life in England. About a fortnight ago the case of the Esquimaux was "disposed of" by selecting only such facts in his natural history as ran parallel with their theory. The material fact was entirely ignored: it is the climate he lives in which affects his diet. The [illegible] and [illegible] nature places within his reach [illegible] teach him to use without stint they are heat producers, and are indispensable to his very existence, short though it be. We have the highest authority for stating that what lowers heat in the body must decrease or lessen life. (See "E. M." No. 987, p. 543, No. 52673.)

Now, Bismarck eats like an Esquimaux, both in quantity and quality, raw ham, to wit. In addition to the Esquimaux fare, he has champagne mixed with beer and cigars to excess; besides other meals, always one long heavy meal late at night, &c. Moreover, it has required generations of Bismarcks, all of the Esquimaux type of eaters, to develop the one high power of Bismarck intellect now before the world. (See Dr. Busch's work on Prince Bismarck, recently published). Bismarck is nearly 70 years of age, but lives in a different climate from the Esquimaux, and his is just the sort of food the German soldier is made of—shinkin, bellona, beer, smoke. I should like very much to see *him* thoroughly disposed of by the vegetarians. If they can convince him that their prescribed course is the one he ought to follow in order to become good and intellectual, active and lively (see "E. M.," Nos. 934 and 935), then they need not write another word in support of vegetarian theories: these will at once pass into the region of accomplished facts. At present their depletory diet pervades and taints their arguments. If they are capable of some *tour de force* of this sort it might resuscitate for a time a belief in their vitality. Abel, "a keeper of sheep." Methuselah, Abraham, Ishmael, David, and Barzillai, who came to succour the latter when he was on low diet, all of whose wealth mainly consisted of sheep, and who must have experienced great vicissitudes in circumstances and health during their long lives. All the priests who received offerings and tithes of sheep, the innumerable hosts of flesh eaters who have passed away during thousands of years, have all contributed to develop a still progressive civilised world. Their spirits, I am afraid, are just now looking down with pity upon the vegetarians, and prompting the recording angel to blot out their vagaries with a "hot-water" tear.

J. D.

THE FRONT-SLIDE LATHE.

[22427.]—MR. CARRE's plan, in letter 23535, appears to me to have several disadvantages. First, the top or face of the bed is better with the channel between, so that rest and poppet can be easily fixed. Next it will be observed that the whole weight of the sliding attachment is carried by the lower V of the bed. This is fixing the support far below the centre of gravity of the attachment; and no matter how well a loose V piece is fitted, it cannot be so firm as a solid one. Therefore, I think it essential in an arrangement of this sort that the upper V should bear all the strain; and the lower loose piece will then have no duty beyond keeping the faces in proper working contact.

To obviate the oil and chip difficulty, why should not the front ledge of the bed overhang the V piece? I do not see that this would be any detriment to the efficiency of the arrangement.

The I form of bed is, without doubt, a very good one, but better, in my opinion, with a ⊥ slot along its upper face, to provide for fixing arrangements. The front ledge may be brought well over to protect the V, which, of course, must be cast sufficiently below the top to allow its angular edge to be planed. The angle block of the carriage may then be brought well up to the level of the bed.

I doubt whether this I form of bed will find favour with mechanics; many would doubtless prefer a light casting of the ordinary plan.

Can any other readers describe the arrangement of the V's, which may have been used in other beds of this kind, such as Cooke's, or that spoken of by Mr. Bear?

Orderic Vital.

Atomic Weight of Tellurium.—The atomic weight of tellurium not corresponding to what it ought to be according to Prof. Mendelejeff's theory of periodicity, M. Brauner has tried to determine it again with greater accuracy. The chief difficulty is to have the tellurium free from selenium, but this difficulty has been overcome, and the body has been obtained in beautiful crystals. As to Berzelius' method for the transformation of tellurium into anhydride, M. Brauner discovered that it is liable to considerable losses, and to avoid them he has had to take the most minute precautions. The process was controlled also by transforming tellurium into a new salt, [illegible], and by the synthesis of the telluride of copper, Cu_2Te. The results are the series of figures varying from 124·94 to 12[illegible], which would give, on the average, an atomic weight of 12[illegible], that is, corresponding to the theory.

The Southern New England Telephone Company are making arrangements to establish a through telephone line which will be over [illegible] miles long. The American Telephone Company are also making experiments with the view of connecting B[illegible] and New York.

EPLIES TO QUERIES.

their answers, Correspondents are respect- uested to mention, in each instance, the title iber of the query asked.

.]—**Lost Watch Wheel.**—P.S. I must not know what is wanted by this query, ıld like to know more.—X.

.]—**Soap Making.**—The common method ıg soap is by saponifying tallow and caustic and then with the aid of common salt ng the stearate and palmitate of potash corresponding soda compound. Pour into ng-pan strong lye, and then add the tallow. as it begins to boil, stir the mixture at s, and keep it well heated for about five The contents then become soap-glue. If ng has gone on well, the addition of fresh ıt to make no difference in the constituency ixture. It ought also to flow smoothly and and not in drops or irregularly. When the ation is finished, salt is added, and the is kept boiling until it assumes a greyish The mother liquor is then run off from the e, to which is added a fairly strong ley, applied. The boiling is kept up, fresh salt being added alternately. The mother again run off, and the soap is then placed oden box, so made that it can be easily o pieces. When cold, the box is un-, and the soap cut up as required.—W. Richmond, Bootle.

.]—**Engine.**—During a late attack of ill- iend sent me some of the back numbers of lish Mechanic to while away the time. In ber dated 26th October, 1883, I find a query, 03, put by "Young Engineer," and in the g numbers I find answers from several s (save the mark!), all of which answers m each other, and the whole of them wrong. prised me greatly. Now if it is not too late deavour to give a solution of the question d simple. Query, No. 52103—Compound —Data given:

n pressure by gauge = 60lb.
s of cylinders = 1 to 4
off in both cylinders = at ½ stroke.
– by gauge = – 13lb. = 2lb.
ck pressure.

to know:—Pressure of steam at points of n both cylinders. Back pressure of steam , final pressure in both cylinders, and No. sions, &c., &c.,

rs.—Firstly, High-pressure cylinders.

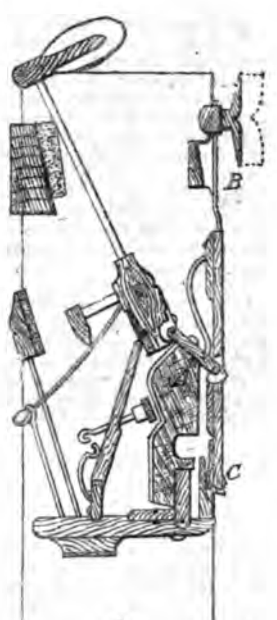
ressure = 60lb. + 15lb. = 75lb. absolute.
at point of cut-off = 75lb.
l pressure = 75 ÷ 2 = 37·5lb.
ressure = 75 ÷ 5 = 15lb., or at the
re of the atmo.
of expansions = 2

lly.—Low-pressure cylinders.
ressure = 37·5lb. absolute.
at point of cut-off = 15lb., and this
k pressure at h.p. cyld.
l pressure = 15 ÷ 2 = 7·5lb. – 2 = 5½.
essure = 2lb.
of expansions = 8.

+ 2 = 10 the total number of expansions, prove this 75 ÷ 10 = 7·5lb., the terminal as shown in low-pressure cylinder, and 2lb. = 5·5 as the final pressure exerted in -pressure cylinder; therefore "Young r" will see that he will have to cut off in a ylinder at $\frac{1}{10}$th stroke to obtain the same Having now answered all the questions, I w try to establish my position and the above But before I do so, let me remark that in such queries as the above you require no f stroke, no area of piston, and no measures. have seen above that our steam in the ssure cylinder at point of cut-off = 75lb. n thence to the end of the stroke it expands volume = 2, and its pressure will, there- 75 ÷ 2 = 37·5lb. This is its terminal , and the initial pressure in the low-pres- linder. In the following calculations for -pressure cylinder, and to save confusion, suppose the high-pressure cylinder to con- volumes and the low-pressure cylinder 8 of steam. Now, the initial pressure of m in low-pressure cylinder = 37·5lb., and lb. would, in ordinary circumstances, when t half-stroke = 37·5 ÷ 2 = 18·75lb. But ot so in our case, for, when the cut-off in -pressure cylinder takes place, there is 1 or half the volume of the high-pressure cut-off and left remaining in that cylinder ver pressure it may be, so that we have nes at 37·5lb., or 1 volume at 75lb., ıg 5 volumes in the high and low-pressure ; then 75 ÷ 5 = 15lb., the pressure at cut-off in low-pressure cylinder, and two expansions afterwards will give 15 ÷ 2 = 7·5lb. for the terminal pressure of the steam in the low-pressure cylinder. It must be borne in mind, however, that we leave 1 volume, or half the contents of the high-pressure cylinder behind at 15lb. absolute or atmospheric pressure; but this is no loss as it forms a cushion on being compressed by the forward motion of the piston, the same as in any other high-pressure engine cylinder. Had this 1 volume not been left behind the terminal pressure in the low-pressure cylinder would have = 9·376lb. Q.E.D. I hope I have now shown "Young Engineer" the way to find out the number of expansions, &c., that take place in compound engines for himself; and should it prove useful to him or any other reader, I shall consider my time while laid up not wasted.—Compound.

[52390.]—**Dynamo.**—The omission of a decimal point before the 6 will explain the seeming mistake. If your magnet is the double horseshoe form, the wire should be wound evenly on the horizontal part of the core, and not crowded against the pole-pieces. You have quite enough wire on.—W. H. E., Coventry.

[52509.]—**Piano Action for Under Dampers.**—Perhaps the simplest, though rather old fashioned, plan of under damping for cottage pianos, is to prolong the hammer butt far enough to impart a motion of about ⅛in., so that the damper may be well clear from the strings when the hammer is checked. The damper would be attached to a long regulating screw, which should pass through a slot in the sticker and out at the front, so that the damper could be adjusted to the strings without removing the action. A more modern method is by centring both hammer and damper on one rest (A). The damper is pressed against the strings by a spring, and may be regulated by bending the wire at B, always allowing a little play between the back of the damper stem and the rail. The motion is communicated by a small crank placed at the end of the hopper lever at C. The loud pedal acts by turning an eccentric roller in the hollow of the rail below A, or it might be by moving the action standards forward, as in the old Broadwood action, though, in that case, the buttons at each end of the action should be replaced by springs.—W. H. Davies.



[52520.]—**American Organ.**—Mr. Floyd places too much confidence in the perfection of his work and abilities, for he cannot reasonably expect to make an organ equal to an established firm which has experienced workmen of undoubted abilities. Mr. Floyd's experience and practice (I take him at his word, p. 543) are not sufficient to accomplish such results as he expects to arrive at, or such results as he has led us to suppose he has arrived at already. Those who only make one or two instruments occasionally cannot expect to make them equal to those who are constantly at the work, and who have facilities for learning beyond the reach of general amateurs. Mr. Floyd is wrong in supposing that I represented the art of reed voicing as a "mystery." I have done no such thing, but I have certainly represented it as a "difficulty," or rather an art requiring considerable practice and experience before any really good results will, or can, be attained. If Mr. Floyd can get a really good diapason tone from a set of reeds, I for one should be glad to know by what means he is able to get it—or, in other words, by what method does he voice his reeds, knowing, from his own assertions, that he never failed to obtain the real diapason tone? If this is true, then Mr. Floyd is wonderfully successful, and great credit is due to him, as he is then able to accomplish one of the most difficult tasks in the art of reed voicing, for in most organs there is a great deficiency of the true diapason quality of tone, which, in many cases, proves its difficulty of accomplishment. I, therefore, envy Mr. Floyd to some extent. How does he determine the difference in soundboards, if made to scale, and of the same material? He says that he has voiced reeds for two soundboards which, he asserts, are exactly alike, and that he has voiced all the reeds for each soundboard exactly alike, and yet each produces a different tone. Stop a bit, Mr. Floyd. Kindly change the reeds, or sets of reeds, on the two soundboards, and report the result. This will prove the correctness of his reed voicing. I am driving towards the truth now, and I trust Mr. Floyd will soon find out that there is something more in reed voicing than what he supposed, or supposes. With regard to cases influencing the tone, I believe our friend Mr. Floyd is right; in fact, I have proved it to be correct from experience.—G. Fryer.

[52520.]—**American Organ.**—As Mr. Floyd (p. 543) thinks I have been "unfair," I must perforce reply, more especially as my critic's want of acquaintance with his subject is likely to lead some of your readers astray. I think he would have been wise had he held his peace about his ability to voice reeds; for he now says that he meant he had succeeded in voicing reeds equal to those he can buy ready-voiced, but that "ready-voiced reeds by the best American makers are not in the market." But Mr. Floyd actually said on p. 433 that he had bought some of the very reeds which are acknowledged to be by the best maker, whatever Mr. F. may think, and he is evidently disappointed. Mr. F. does not tell us how he treated them, but proceeds to make any reed-voicer who reads his remark smile loudly at his notion that voiced reeds ought to be "tried and individually corrected in an instrument." Further down he tells us he can accurately reproduce the bend and twist, and he may believe me that if he can do that he can do all that he will ever get in the shape of voiced reeds from the "best-best" maker that ever tried his hand at it. If Mr. Floyd had ever tried the effect of finishing and tuning a set of reeds in one instrument and then transferring them to another, he would know that makers never pretend to finish or fine-tune reeds until the reeds are where they are going to stop. Mr. F. is self-contradictory, because he will have it, rightly enough, that the board and even the case have some effect on the sound; and what is more, he accuses me of seeming "to consider one board as good as another," when all I did was to laugh at Mr. Floyd's notion of makers turning out all the bad boards. I do not know how short may be Mr. F.'s experience, but if he would only think twice he would see that it is not an easy matter to try boards with a "well-voiced set of reeds," unless they are fitted with a set of pallets; and a maker having gone so far as that, is very apt to go further and finish the instrument. Something more must be done than "clamping on a windchest." I think it very likely that boards built up of several pieces of yellow pine will yield better results than those made of spruce; but I am quite certain that the difference is not so great as between reeds voiced by different men, and not so perceptible to the average ear. Mr. F. is mistaken in what he says about "Elève" (that gentleman did make some remarks of the kind, but it was in connection with a "harmonium pan"); and he also takes nothing by mentioning that "Joiner's" instrument has three rows of 16ft., because one can refer to p. 219, Vol. XXXV., and find that it is a two-manual, and that two of the three 16ft. registers are solo stops, and note also that there are four 8ft. registers to cover them, whereas in Mr. F.'s instrument there are two of 16ft. to one of 8ft. I should now like to know *how* Mr. F. has arranged his half set of 16ft. at the back, because it strikes me that an "ordinary three-row" board does not have a half-set stuck at the back; so that if Mr. F. has made the tubes and cut the pallet apertures, it would be interesting no doubt to some of your readers to have more particulars. It is no part of my business to criticise the work of distinguished makers of the American organ; but what Mr. Floyd says about his erring in "such good company" in no way affects my opinion. As he does not seem to know what the instrument he refers to really contains, I may tell him that it has three full rows of respectively 16ft., 8ft., and 4ft.; one and a half octave of 16ft. (Musette), and an octave of sub-bass (16ft.) The model is expressly stated by the makers to be a special one made to a specification supplied; and the simple fact that they have no other one-manual instrument with a 16ft. register in the treble, unless accompanied by at least two 8ft., ought to have opened his eyes. If he is satisfied with his instrument—if he really thinks it can be compared with the model he mentions—well and good. I understood from his query that he was not, and therefore ventured to express my opinion. Like the parrot, I am now sorry I spoke.—ORGANON.

[52549.]—**Unfermented Bread.**—Mr. Allinson will perhaps be glad to know that if the wholemeal flour is mixed with milk instead of water, the bread is much lighter and shorter, and altogether greatly improved. I have used it for some years. —L. C.

[52551.]—**Small Steel Balls.**—Seeing this remains unanswered, I offer you the best plan I know—that is, turn your ball as round as possible with ordinary hand tools in a lathe, then make a wood or lead chuck; turn same to receive your ball about a third its dimensions. Then you require to make a cupping tool from a piece of steel, one end to be turned perfectly true inside and out, just to cover about one-third of the ball, and tapered down to 1/16in. thick. Now take your steel ball, and put it into the chuck in lathe, holding it in with the cupping tool you have made, set on your lathe, and keep working your tool over as much surface of the ball as possibly, occasionally turning the ball round. See that your cupping tool is nicely tempered, and then you will get your steel balls quite true.—W. M.

[52626.]—**Wimshurst's Influence Machine (U.Q.)**—"J. J. H." is wrong in making the sectors so broad—¾in. at the broad end is quite enough. Then as to the two sectors on each plate being raised in the centre to just graze the brushes, this is not following the description in "ours," which, I think, was "that each and every sector must in its turn touch the brushes," and that the two opposite sectors on the same plate must touch, and afterwards end their touch at the same instant. All else in his description is right; he, however, omits to state the distance between the plates, and the number of sectors on each plate; the plates should run as close together as possible without touching. Twelve sectors on each plate for general purposes gives the best results; about 4½in. length of spark can readily be got with 14in. plates and good Leyden jars. I see in this week's issue "Another Amateur" gives very good dimensions for the sectors.—A MAKER OF MANY SUCH MACHINES.

[52654.]—**Point of Greatest Transverse Strain.**—Palmer's reply on page 543 refers to a beam with 4½tons 4ft. from one support, and 5½tons 6ft. from the other, to which a *rigid* mass is equivalent under the conditions he mentions. But the mass intended by "Querist" is a built-up one, like a stack of pig-iron, for instance, for which the calculation is so complicated.—J. S. C.

[52710.]—**Wheel-Teeth Calculation.**—I presume "Clockmaker" requires integral sub-multiples of his numbers. The best way to obtain them would be:—Resolve the given number into its prime factors (numbers divisible only by themselves and unity), and combine these to obtain the number of factors required. This rule will cover both questions of his; but he must notice two things:—1st, if the number of multiples he requires be greater than the number of primes, the problem cannot be solved; 2nd, a number may often be thus factorised in numerous ways.

Thus, 64,800 = 32 × 81 × 25
= 2·2·2·2·2·3·3·3·3·5·5,

and these may be arranged in a number of ways. If "Clockmaker" is familiar with elementary mathematics, he will find much that is useful in Todhunter's larger algebra (pp. 422, *et seq*).—EGSROW.

[52710.]—**Wheel Teeth Calculation.**—"Clockmaker" will find the following method a sure way of finding factors of any proposed number he may wish. Take the number 64,800, divide it and the successive quotients by 2, as far as possible (without remainder), then by threes and fives, &c., until quotient be only 1, as here shown:—

	Divisors.	Quotients.
	2	64800
a	2	32400
	2	16200
c	2	8100
	2	4050
	3	2025
f	3	675
	3	225
d	3	75
	5	25
	5	5
		1

Now, if three numbers be required, such that when × into each other shall produce such a product as the above, select such divisors × into one another as shall produce the most suitable numbers for the wheels. Such as the three top 2's (a) and one 5 at the bottom (b) × together: thus, 2 × 2 × 2 = 8, × 5 = 40; then a 2, a 3, and a 5 (c d e), thus 2 c × 3 d = 6, × 5 = 30; and, lastly, the remaining 3's and the 2, thus 3 × 3 × 3 = 27, × 2 = 54, which being × by wheel 40 = 2160, × wheel 30 = 64800. Another set can be selected, such as two 5's and a 2 = 50, four 3's = 81, and four 2's = 16; each set being involved become factors of 64800. As regards the latter part of this query, I think the above method will answer all that may be desired, but when the querist says four or five "multiples" I must ask of what? For a multiple is a quantity, or number, so many times repeated, as 2 + 2 + 2 = 6, the multiple, = 3 × 2 = 6, the 3 and the 2 being factors. But I will take it that four or five numbers are to be multiplied together, their product to equal a certain number. The above method will do it, though if the required number be a power, such as the 2nd, 3rd, 4th, 5th, &c., the root will be that number which when involved will become the required number, such as, for instance, 81 = 3 × 3 × 3 × 3 = 4th power. I wish some one else had answered this query; but finding it has got into the place it has, on page 546, I thought it best to get it out. See back numbers of "E. M.," Oct. 19, 1883, p. 157, and Oct. 26, 1883, p. 179.—X.

[52715.]—**Steam Launch.**—I have not time, just at present, to look through my back volumes and make a list of the places where "P. W. R." will find the information he requires. Life is so short, and "P. W. R.'s" knowledge evidently so little, that he really should not waste his time in what he calls "joking." If I knew how to drive a 12ft. boat at more than eight miles an hour through still water, I should take out a patent before publishing the news.—NUN. DOR.

[52715.]—**Steam Launch.**—If "P. W. R.," in his joking reply on p. 543, where he makes an attempt to ridicule "Nun. Dor.," had carried out his multiplication table, he would find that a launch or boat 12ft. by 3ft. would carry, say, 1 ton, and her ribs would be about 1in. square, and planking about ½in. thick. A ship 300ft. long, carrying 1,000 tons, would have, of course, ribs 1,000in. square, and planking 500in. thick. This is as reasonable as talking of a ship 300ft. long, 96ft. beam, going through the water at 192 miles per hour. "P. W. R." does not allow for the increase of friction as the speed increases. Water under pressure is a troublesome thing to deal with. No ship has ever yet been built to stand the racking of any motive power sufficiently strong to project her through the water (and especially troubled water), at the rate of 24 miles an hour. I do not say this will never be done, but builders and shipowners cannot afford to use up all the room in a ship for the sake of testing the maximum of speed to be got out of the same. As vessels are increased in length they cannot in the same proportion be increased in width, because they would be so stiff and offer so much resistance to a cross sea. The motion would be so sharp and quick, that nothing could be kept in place, and the poor unfortunates on board would be thrown off their legs, and wrenched away from anything they might lay hold of, or be bruised to death by a motion in the opposite direction.—WM. HOSKEN.

[52728.]—**Deposit in Water Cistern.**—Obviously, the "red spotted rust" is iron; but exactly whence it cometh would require a little examination to determine. Most likely the cistern is imperfectly coated with the zinc—that is, there are pinholes in the covering, and through these the iron is rusted, the action being assisted by the fact that the iron and zinc make a voltaic couple. If so, the cistern won't last so long as it would have done without the zinc plating.—WATERMAN.

[52729.]—**Bronzing Mounts.**—This can be done by means of Bessemer's paint; or by brushing over gold size, printers' or other suitable varnish, and then dusting the powder over, wiping when dry and fixed with a tuft of cotton wool.—NUN. DOR.

[52730.]—**Legal.**—This question of "nuisance" is very much a matter of opinion. The law is clear enough: if it is a "nuisance," why then you will have to shift your engine; but a judge would require very strong evidence, or it would rest with a jury, according as the case is tried. Better take the advice of a respectable solicitor, who will examine the spot; but I think if the engine is 23 yards from a public way, and not near any houses, it would puzzle the other side to prove a "nuisance." —LIMB O' TH' LAW.

[52736.]—**Gelatine.**—This is a question to be settled by experiment. There must be gelatine in ham-rinds; but whether it is worth the trouble, or can be obtained, is another matter.—ECONOMY.

[52761.]—**Consumption.**—"Muse" asks a very important question, and one of vital importance, How to prevent chronic lung complaints from turning to consumption, or how to cure consumption in its first stages? Such a consummation cannot be arrived at by drugs, but must be done by careful attention to hygienic and dietetic rules. In the first place, all lung complaints mean a deficiency of fresh air; in the second place, they are aggravated by foods which require much oxygen for their oxidation (as flesh foods), and they are also made worse by lowering conditions of any kind. If "Muse" wants really to get rid of his complaint, he must change his occupation for one in which he is more in the open air; or, if he cannot do that, he must make it a rule to be out in the open air as much as possible, and even sleep with his bedroom window a little open. Secondly, he must adopt a diet which will digest very easily, and not supply his system with too much waste material. A non-flesh diet will best supply him with nourishing food not too rich in waste products. For breakfast, he can have a porridge made from an equal mixture of oatmeal and wheatmeal; a basin of this, eaten with milk (as he is losing flesh, he might mix a tablespoonful of olive oil with it), if well mixed, he will not taste it, and it will not repeat. Let this suffice for the first meal. Dinner, five hours after, may consist of a plain soup and brown bread, followed by a rice, sago, tapioca, or hominy pudding, made with milk only and a very little sugar. Tea meal, five hours after dinner, may consist of weak tea, coffee, or cocoa, or hot milk, for drink, with wholemeal bread and butter. Let this be his last meal. In chest cases, the stomach always sympathises with the lungs, and so the patient loses weight by not being able to digest the food. Again, flesh food often gives rise to pain in these cases, or brings on an attack of coughing, which ceases not until the offending food is vomited. When we know that the lungs and stomach are supplied by the same nerve (pneumo-gastric) we see the cause of it, for anything irritating the stomach end of the nerve gives rise to coughing, which may induce vomiting, and thus relief is got. Again, flesh food often gives rise to night sweats, which are, I believe, an effort of the system to relieve itself from waste products. These sweats are very weakening, though. Thirdly, he must attend to his skin, and keep it open, for the lungs and skin are both blood purifiers, and when the lungs are disabled we must try and make the skin do some of their work. This can best be done by means of daily tepid baths, or sponging the whole body with lukewarm water once or twice daily, to be followed up by a brisk rubbing down with a rough towel. If "Muse" will try and follow these rules I will promise him cure. These rules are also very useful for the first stage of consumption, and if properly carried out, will save many from an untimely grave. Consumption in its early stages can be cured, and even in its more advanced stages much relief may be got from following simple hygienic and dietetic rules. If my professional brethren would use more hygienic rules, and less physic, consumption would not be reckoned so fatal a malady as it is.—T. R. ALLINSON, L.R.C.P., 34, Claremont-square, N.

[52767.]—**Lathe Bearings.**—This querist should look up his back numbers. The wear is taken up by a turn or part of a turn of a nut, driving the mandrel further in.—T. G.

[52796.]—**Income Tax.**—I don't think you can be charged, if the property pays all taxes in New Zealand; but clearly if anyone resident in this country derived his income from property abroad he would have to pay the tax.—S. T. J.

[52824.]—**Governors.**—The small balls have the advantage of not wearing the suspension pin guide, pins, footstep, &c., so much as the large balls do. But it is the length of the arm and the angle it makes with the vertical shaft, or the distance from point of suspension to plane of revolution by which the action of a governor is regulated.—ENGINEER, Dewsbury.

[52840.]—**Core Box for Globe Valve.**—As you are a pattern-maker, I need scarcely allude to the pattern itself for a globe valve, except in so far as it may be useful to others. It might be jointed in the plane of Fig. 1 (vertical section), and be either worked out of a solid piece, if of small dimensions; or if large, the globular part would be turned together with the inlet and outlet ends and their prints—the branch for the screw gland being turned separately and fitted on. Or the pattern might be jointed at right angles to the plane of Fig. 1—that is, vertically—and the branch be moulded downwards: and this I consider the better way, as more convenient for laying in the cores. A small valve has usually nut-shaped ends as figured, and screwed within with gas-taps for the attachment of the piping. But large valves have often flange attachments, both at the ends and on the top, and in the latter case the top flange will be left loose, if the branch is moulded downwards. But the core is the thing, and that is not made in one, but in two. Form two separate boxes, and fasten together with claywash before being put into the mould. Looking at Fig. 1, A is one core and B is the other, and they are connected together by the prints shown dotted in the figure. In setting to work, just dismiss core B from the mind for awhile, and start about making a box for A. I have shown three views of the box (Fig. 2), A showing the appearance of the box viewed from its outer end; B, in sectional plan, looking on the face of the core box joint and downwards; C, a sectional elevation cut longitudinally through the box. The necessary lines of course you know how to mark from your drawings. You can see now clearly that the box

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

A NEW VOLUME.

This number is the last of Vol. XXXVIII. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXVIII. will be published on March 21, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 27, and unacknowledged elsewhere:—

J. H. Cussen.—J. and H. Grace.—W. F. Stanley.—Leroy and Co.—T. Taylor.—Mawson and Swann.—J. Wimshurst.—G. W. Weeks.—Arthur Henry.—J. Reside.—R. Hughes.—H. King.—J. H.—Expertus.—W. H. Baldwin.—O. V.—T. W. Smith.—W. Shield.—Moongazer.—George Templeton.—F. P.—P. E.—Coppersmith.—G. R.—Economist.—Enquirer.

J. Lawrence. (Perpetual motion is the thing for you! That is the only way we know of getting a machine to go twenty-seven hours a day, eight days a week, all the year round, and this really seems what you want.)—B. S. L. (Natural flowers may be preserved by taking them when fresh cut and dipping them in paraffin melted enough to maintain its fluidity. Move the flowers about very carefully in the liquid so as to remove all air bubbles; withdraw quickly and hold a moment to dry.)—Table Decoration. (Here is one way by which you may florally designate places at table for your guests, if you have plenty of violets or other small blooms to spare: Have an alphabet made of tin, have each letter about three inches high and the little tin forms deep enough to hold a little sand or wet moss. Then fill the forms with tiny flowers and leaves.)—Demagnetised. (The query has been answered over and over again, and directions are given in nearly every textbook. A great deal depends on the nature of the steel; but it is usual to magnetise either by drawing a permanent magnet in one direction over the bar, or to use a coil of wire through which a current is passing, and lead that along the bar it is desired to magnetise. You do not state the shape, whether bar or horseshoe.)—A Sufferer. (It is impossible to learn from your reply even the nature of the rheumatism, whether it proceeds from rheumatic gout or from the acute or chronic form. See p. 154, Vol. XXXV., and the indices generally.)—Mechanic. (Rub soap over the part, scratch the lines with a needle, and then fill them with nitric acid, the aquafortis of the shops.)—Horatius. (See Dr. Stone's note on p. 5, Vol. XXXVII., or Dr. Edmunds's, p. 430, Vol. XXXV.)—Sportsman. (Canvas-back 'ducks are specimens of the *Aythya vallisneria*. They reach the United States from the north in October and about November are in prime condition. Caught largely in Chesapeake Bay.)—H. A. (Either the glass is not clean or the plaster has perished. Procure the best plaster, and see that the glass is thoroughly clean. About the consistency of paste. If the plaster is fresh and good, it practically burns into the surface of the glass and cannot easily be removed.)—Inquirer. (See the indices, or consult the lists of those who sell hot-water fittings. The boiler would be placed at the back of the grate; but it really requires examination of the place to determine what would be best arrangement.)—Cyclist. (We suppose you mean the Wealemefna; but the names of the instruments are the opisometer and the chartometer—sold by all dealers in drawing instruments, such as Stanley.)—Eachin. (The remedy is to paint the tins and stick the labels on that.)—Amateur. (See the indices, and pp. 242, 303, 368, present volume.)—W. H. W. (See p. 441, Vol. XXXV. There are several things of the kind; but it is doubtful whether they are worth anything.)—Ignorance. (Apparently it wants cleaning out; but your description is very vague. Do not understand what you mean by a waste.)—D. T. (See any textbook of chemistry, or dissolve it in sulphuric acid.)—Animalcula. (Prof. Westwood, of Oxford, read a paper on the subject at the 1879 meeting of the British Association, an abstract of which you will find in Vol. XXX., p. 81. If you could catch some of the depredators and send them to Prof. Westwood he would identify them for you and indicate a remedy. Russia leather is said to be proof against them, and as that derives its peculiar scent from oil of birch, you might try the effect of that in your bookcases. You will find several remedies suggested in P of. Westwood's paper.)—Self-Taught. (They are merely examination questions, for which at present we have not space.)—H. W. H. (See the indices. The only satisfactory method is exposure to bright sunshine under the protection of glass.)—Try. (See the list of Back Numbers at the head of this column first week in each month. Copying Processes is the heading.) X. N. X. (It was omitted at the last moment, owing to the exigencies of printing. With some others it was in type, but had to be held over.)—E. J. C. (The recipes appeared under the head "Moire Metal," in Vol. XXXVII. p. 320.)—Pip. (Have you read what has appeared on the subject. See p. 226, Vol. XXXVII., and the indices generally.)—T. S. P. (You will probably find good Brunswick black as serviceable as anything; but some prefer to blacklead. Coal-tar well boiled and diluted with turpentine and boiled oil is a good paint for such purposes.)—Gunner. (See p. 605, Vol. XXIX. All that is needed is a chamber, into which air is pumped at a high pressure; the trigger opens a valve in this and the air escaping drives the bullet or dart out of the barrel.)—E. C. Alcock. (The registration of a trade mark costs 5s. for the stamp on application, and a pound before the expiration of every fourteen years.)—P. C. W. (You could try Brunswick black or Japan varnish; but surely porcelain or guttapercha is cheap enough.)—Gamma Alpha Sigma. (See the indices, for something has been said that may be of use; but you should procure the handbooks issued by Gordon and Gotch, St. Bride-street, or seek advice from the Agent-General to the Colony to which you wish to emigrate.)—Adam. (Do you not see that such a query would bring replies which would be advertisements, although they might not be meant as such.)—G. R. K. (It does not matter. For convenience it is generally placed at the end where the primary wire commences. Very shortly now, we believe; but ask Messrs. Spon.)—Organ Repairer. Whatever do you mean? What sort of an organ is it, and which G sharp?)—Brento. (Impossible to say without seeing it. The spring ought to be strong enough to pull it back. Perhaps contact is not broken—that is, the battery circuit—and the core acts as an electro-magnet.)—A Duffer. (Not without apparatus quite as complicated. The wires should be marked. 2. A motor of the kind was described on p. 113, this volume. 3. Apply to the Secretary, South Kensington. There are special regulations for persons residing where there are no classes.)—A Lancashire Lad. (You want an ordinary inside tool. Surely you have one of the handbooks which explain those matters.)—Grocer. (Boil a weighed quantity in water. Allow it to settle and cool, and then weigh. That is a rough test of the addition of adulterants.)—Lowlander. (It is not in the list. We know nothing about it. 2. Not yet. The brake pipes are disconnected at the previous station, and the carriages slipped by the link illustrated on p. 319, Vol. XXXVII. The trains on the L. and N.W. were given recently we think. We know of no other book of a descriptive kind.)—Saxon. (Apply to the Secretary of the Institute, 3, Copthall-buildings, E.C., or see p. 307, Vol. XXXII.)—Emigrant. (Procure the lists of Lockwood and Co., Stationers' Hall-court, E.C., and Spons, Charing-cross.)—Young Enquirer. (Is not the matter treated in "Notes on Plumbing"? The best joints are made with flanges and rubber rings. Handbook on the subject frequently advertised in "Sale Column," See p. vi., Feb. 8, for instance.)—Phœnix. (We have inserted many similar diagrams, and the replies will supply all the information needed. See the index of the last volume.)—W. F. Gardiner. (Just the same as other insects are preserved. 2. The area included between Chingford, High Beech, Epping, and Loughton would appear to be the best hunting-ground.)—Learner. (See p. 476, and the indices generally. 2. An answer would occupy too much space; it must be looked for in the official instructions or in works on meteorology. 3. Examining the water, and comparing its analysis with the rate of flow.)—W. Clark. (When you write again about something you do not understand, it would be advisable at least to spell correctly, and arrange the words in grammatical form. What do you know about "the nervo-vital fluid," or of the cause of the "viger and activity witch wee witness in the young"?)—E. T. (Have no space for queries about banjoes made out of cocoanut shells. You must experiment for yourself; perhaps you may make a discovery.)—W. H. Hall. (The method has been described over and over again, and recently. If the articles are not sufficient guide, you must wait. We cannot afford space to give measurements and details of every size asked about, though all the size you mention is the highly definite description "small one.")—Forward. (Your five questions are answered by the simple statement that there is not an examination of the kind. Anyone can put C.E. after his name.)—Frugal. (We should say any man just now who placed money in an "Advance and Deposit Bank" on a guarantee of ten per cent. interest would lose his money.)—David Smart. (We cannot reproduce the sketches satisfactorily, best thanks all the same.)—An Ignorant One. (You must take out a license if you sell certain articles—such as sweets, tobacco, wines, &c.)—W. C. S. (He will have to pay it, or prove to the satisfaction of the Commissioners that he is losing as you say.)—Gibraltar. (We doubt if such an invention would ever pay the costs of the patent. Any of the agents advertising in these columns will answer your other questions.)—A. Robinson. (Do not listen to croakers, but take medical advice. The people who "have got worse instead of better," would probably have got worse still if they had neglected the matter.)—R. H. Bleasdale. (You have your remedy if the case is as you say. We cannot exclude advertisements on such representations. If we did we should have to assume a similar responsibility in all cases.)—Bridgwater. (Your father's marriage will invalidate any previously made will, and should he die intestate you and the other children of either marriage will share his personal property equally.)—Schiox. (Why not look for yourself? Try No. 986.)—W. J. Goldsmith. (Do you not think it rather absurd to send such a cutting to us? See the indices of back volumes, and pp. 121, 362, 368, 393, 431, 471, 473 of the present volume.)—Multipot. (The best way is to use a cupola, which you will find described in back volumes.)—J. W. or X. A. B. (The book you mean was advertised on p. xi. of the number for Feb. 15.)—B. (The necessary recipes will be found in the back volumes; but you will probably find the aniline dyes sufficient for your wants.)—M. E. C. (We have heard that the essence of pennyroyal, or fresh sprigs of the plant, scattered about the room will drive them away.)—Luke. (See the indices and recent back numbers.)—Thomas Plunkett. (Not on the small scale; but you do not want illuminating gas for the purpose. See p. 154, Vol. XXXII., and the indices. Also p. 527, last week's number.)—Samuel Smith. (All the information necessary was given on p. 431, Vol. XXXVII. You never will make them soft until you work them well, instead of allowing them to become dry and hard.)—Inquirer. (Three ounces of shellac, half-ounce of benzoin, to a quart of rectified wood naphtha, make a good polish. For directions, see many back numbers; but full instructions will be found in Vol. XXXII., pp. 175, 227.)—Confectioner. (You mean a pyrometer; write W. H. Bailey and Co., of Salford, for prices, &c.)—Carnivorous. (It is very much a question of temperature. Tough meat, and generally speaking, the flesh of wild or undomesticated animals is better hung as long as possible before being cooked. Fresh venison, for instance, is decidedly unpalatable, and—we write in wholesome fear of vegetarians and others—we think unwholesome. Given bright, clear, cool weather, like that we are enjoying as we write this, and a leg of mutton may safely hang a fortnight, and taste all the better for it; while in hot summer weather it would stink before the first week was over.)

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

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Declining Business.—Forty English Lever **Watches**, a few Chronographs. List free. Offers requested in part exchange. —R. Powall, Prescot, Lancashire.

Wanted, **Ironing Stove**, flat top, 10in. square, piping, for splendid high-class copper and plaster medallions, or Fletcher's foot blower.—Ward, Woodlands Park-road, Greenwich.

Exchange for Tricycle **Two No. 1 Thomas's** Sewing Machines without treadles, warranted in good working order.—E. T. Baker, East-street, Ilminster.

Wanted, **Iron Printing Press**, to print 12in. by 16in., with or without type, will give in exchange chassepot breechloader and sword worth 30s. and cash, or part exchange in jewellery and cash for good article.—E. Wilton Newton, Camborne, Cornwall.

Telephones, a short time in use.—Pair of complete simplex telephones, each instrument has Strangways' microphone, bell, switch automatic and ear-tube receiver; exchange Fletcher's furnace, blower, tubing, and generator, or value £4.—T. Plunkett, Portmarnock, Baldoyle.

Electric Machine, 10in. by 6in. cylinder; London only, particulars free. Exchange for Lancaster's Instantograph, ½-plate.—C. Parker, 15, Osborne-grove, Upper Tollington-park, N.

Electro-Plating.—Gallon Smee, good order; lot of steel and agate burnishers; exchange clothing.—G. E., 25, Chandelier-road, Stratford, London, E.

A first-class 6in. centre **Lathe**, with back-gear, slide-rest and chucks, 5ft. 6in. bed, too large for owner, who wants one about 4½ and much lighter.—Levi, 120, Hammersmith-road, W.

Lancaster's half-plate **Lens**, stand, and double back; also home-made camera, in exchange for scientific apparatus, or offers.—A. Chambers, 6, Gordon road, West-hill, Hastings.

Wanted, **Tricycles**, single or sociable; condition immaterial; give in exchange bicycles in perfect condition, new if desired; good value may be relied upon.—W., 59, Maxey-road, Plumstead.

Wanted, anything useful to engineer in exhange for 50in. Singer bicycle, perfect condition.—W., 59, Maxey-road, Plumstead.

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Wimshurst Machines.

Wimshurst Machines.—See Banks.

Wimshurst Machines.

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